

PROSTOR

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ZNAKSTVENI ČASOPIS ZA ARHITEKTURU I URBANIZAM

UNIVERSITY
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FACULTY OF
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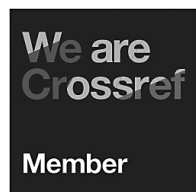
PROSTOR *m* space, room; (*površina*) area; (*zona*) tract; (*prostranstvo*) extent, expanse; (*za kretanje/manevriranje*) elbow-room, playroom, leeway, scope; (*prostorije, smještaj*) premises, accommodation | **životni** ~ living space; **stambeni** ~ housing; **školski** ~ school space; **poslovni** ~ 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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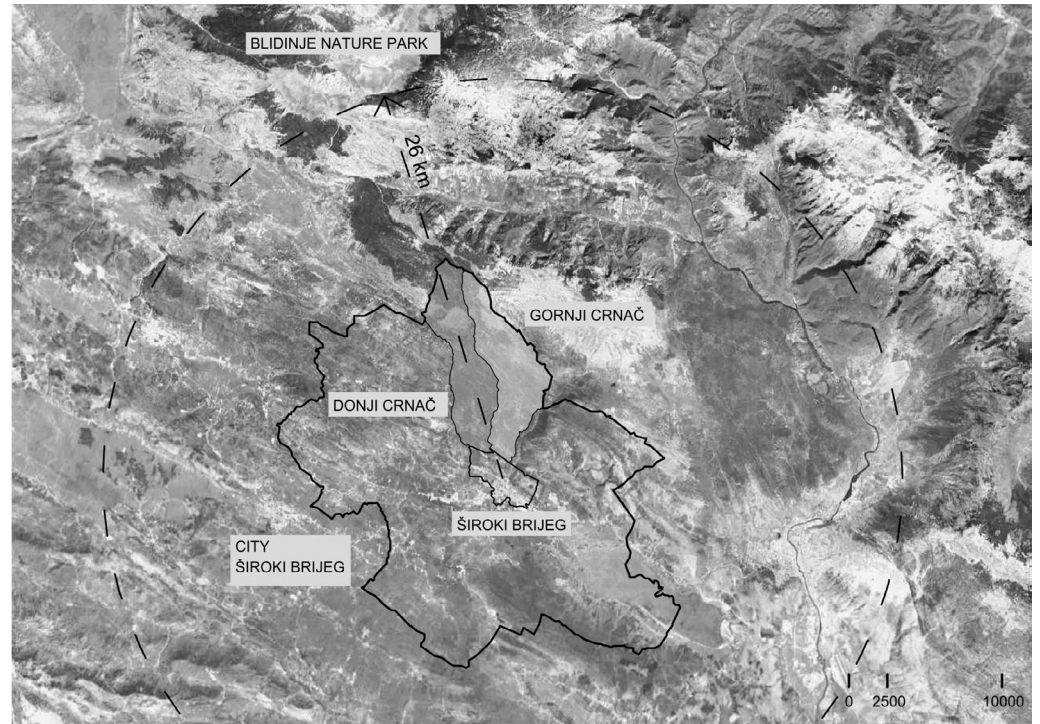


FIG. 1 LOCATION OF THE STUDIED AREA

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TRADITIONAL HERZEGOVINIAN RESIDENTIAL ARCHITECTURE OF GORNJI CRNAČ

CRNAČ – ŠIROKI BRIJEG, BOSNIA AND HERZEGOVINA
STONE CONSTRUCTION
TRADITIONAL ARCHITECTURE
WOOD CONSTRUCTION

The village of Gornji Crnač, part of Široki Brijeg, in Bosnia and Herzegovina, offers insight into the authentic traditional construction of the Croatian population of Herzegovina. The heritage, however, is at risk due to the village's depopulation. To build upon previous research and to assess the current preservation state, a field survey in the preserved hamlets was conducted, along with the interviews of the few remaining inhabitants. Some hamlets were permanently inhabited,

while others were occupied only seasonally. Built with stone, structures have remained physically preserved and authentic, intact by decades of abandonment that shielded them from alterations, and modifications. It was found that previous research, focusing on the traditional housing construction techniques of the broader Široki Brijeg area, overlooked the distinct features uniquely crafted by local builders in the village.

INTRODUCTION

The village of Crnač, the largest in north-western Herzegovina by area, belongs to the city of Široki Brijeg. It is located north of the city, geographically divided into Gornji i Donji Crnač (Lower and Upper Crnač). The village was first mentioned in 1468 in the Turkish taxpayer list and was named after the black color of the ash leaf (MZ Crnač, 2022). According to climatic characteristics, the village of Crnač has dry and hot summers, and the mountainous areas with lower temperatures provided better conditions for grazing livestock. The population used the so-called summer and winter housing (Rajić, T., 2023). The cattle migration lasted from 1 June to 29 July, and had three phases: 1. migration to the “lower grasses” – if the year was warmer at the end of January, 2. migration to the “middle grasses” – after the Feast of the Annunciation (*Blagovijest*) on 25 March, and 3. migration to the “upper grasses” – after the Feast of Saint George (*Durdevo*) on 23 April (Šaravanja and Oreč, 2022: 181). During the warmer months, most migrations gravitated towards the area of the present-day Blidinje Nature Park, to hamlets in the area of Čabulja mountain (Popović, 2008: 63-67), and to a lesser extent within the borders of the villages (Fig. 1).

The initial settlement of these places was driven by access to fertile land and pastures for grazing. The hamlets themselves emerged

as families expanded and new households separated from the initial family household. The most significant resource shaping construction in this area is stone, which has played a crucial role in its architectural history. As a result, physical remains of traditional residential construction in the area still endure. The architectural concept and construction are a direct reflection of the surroundings, with buildings emerging organically from the landscape. The techniques and knowledge associated with the traditional architectural heritage of western Herzegovina have been preserved mainly through oral tradition, while written sources on them remain scarce. Franciscans, the main disseminators of knowledge, literacy and culture in Herzegovina, documented the population and the region through their records. However, such documents were preserved in fragments since the archives were burned in 1945. In the review of genealogy and indigenous peoples in this region, Mandić (2002) states that the population is predominantly Croatian and those migrations occurred between Herzegovina and Dalmatia due to Turkish influence in western Herzegovina. A review of the basic characteristics of folk architecture in Dalmatian regions (Freudenreich, 1962) reveals their similarities with the traditional architecture of western Herzegovina. A literature review records information on the traditional architecture of western Herzegovina – to which the village of Crnač belongs – primarily through analyses of individual elements such as walls, lintels, roof structures, and fireplaces, rather than through studies of houses as integrated systems in their cultural context. Bugarski has so far provided the most detailed description of the rural architecture of this area (Bugarski, 1970: 135-173). Research conducted by her team in 1970 led to the conclusion that, in the area of Široki Brijeg, a transitional form between the true stone house and the wooden house was widespread. The primary types of residential buildings had both significant residential and economic functions; functions that were gradually abandoned – though not entirely – at the time of the study. However, a comprehensive overview remains incomplete due to insufficient documentation: “According to folk tradition, it is known what the rural house in the surroundings of Lištica looked like in the first half of the 19th century, that is, at the end of Ottoman rule in Bosnia and Herzegovina. Due to the lack of historical documents and insufficient archaeological research of this area, it is difficult to determine what it was like in earlier periods.” (Bugarski, 1970: 171-172). *Ecoplan's Handbook* (***) (2016) is a resource offering insight into the

historical aspects of construction, guidelines for renovation, and contemporary reference examples of construction in Herzegovina, where historical motifs remain deeply embedded. More recently, Šaravanja and Oreč have explored dry-stone construction, which has endured over time to present day, that also offers insights and knowledge about residential complexes that differed under the influence of the period, location, quality and processing of the stone of the village houses (Šaravanja and Oreč, 2023). They were architecturally simple small stone houses with a single-room rectangular floor plan, measuring 6-7 by 4 metres. They were built on a sunny side, sheltered from the wind, most often semi-buried and built on the rock. They had an open hearth, wooden roof structure, compacted earth floors, and the only opening was a small door on the longer façade. Palavestra argues that the population of the Široki Brijeg area – and its surroundings, including Crnač – embodies the full range of elements characteristic of the entire population of western Herzegovina (Palavestra, 1970: 5). However, as stated: “The contributions published here, of course, cannot represent all areas of folk life that require ethnological analysis and highlight the need for ethnological study. There was a lack of strength, time, and resources for that. I believe that the data contained in the individual works published here also need to be further deepened through fieldwork, since it is undoubtedly true that we have not exhausted the full richness of the folk culture of the inhabitants of that area.” (Palavestra, 1970: 5). Today, however, these locations are marked by inaccessible and abandoned architectural complexes and buildings. Moreover, the older residents who once lived in these traditional settings still recall the time of construction, and possess detailed knowledge of the building techniques employed and architectural features used in traditional housing. Therefore, it is necessary to further document and better understand traditional architecture, which is irreversibly disappearing due to urbanisation and the abandonment of this area.

METHOD

To obtain deeper insight into the knowledge about traditional housing and construction techniques of western Herzegovina, a field survey of the physical remains in the selected area of Gornji Crnač was conducted. Characteristic elements of stone and wooden structures were identified, photographed, sketched, and captured through diagrams and notes. Accounts from local residents

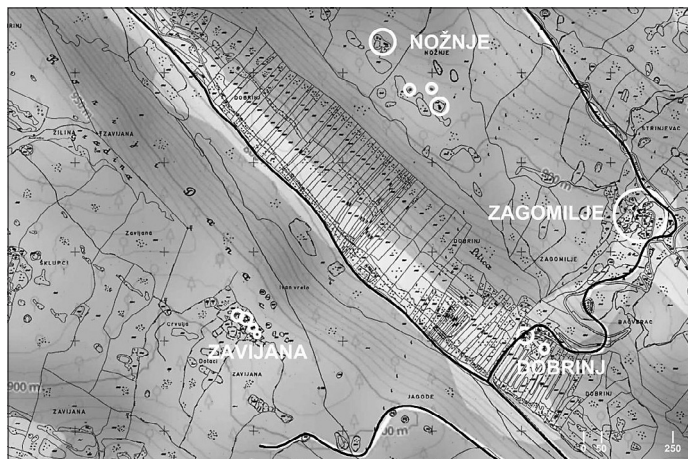


FIG. 2 LOCATION OF THE HAMLETS AREA

were collected to provide additional insights and to complement existing knowledge of traditional housing construction of the period. Of the thirteen residents who provided their accounts, all were born in Gornji Crnač. Eight still live in the village – six in Gornji and two in Donji Crnač – while four live in the city of Široki Brijeg, and one lives in Mostar. The informants' age ranges from 50 to 83, with five individuals under 65.

HAMLETS

The village follows the dispersed Dinaric settlement pattern, with compact hamlets forming smaller clusters in which groups of the same kin and surname lived (Bugarski, 1970: 136). According to the accounts of six informants, there were subgroups within the groups, with nicknames derived from the mother's maiden surname.

The area of Gornji Crnač was surveyed, including the following preserved hamlets: Zavijana, Nožnje, Dobrinj, Pod Greda, Jabuka, Podi, Pod, Zagomilje, and Žukovica. Some of these hamlets were intended for seasonal and some for permanent residence of the local population (Bugarski, 1970: 136). Permanent settlements include the hamlet of Podi, home to the Naletilić family, Pod Greda and Jabuka, where the Karacić family resided, and Dobrinj, belonging to the Ljubić family as provided by the living members of the family. Zavijana was a hamlet designated for temporary summer residence of the Šaravanja family, from March to early June and from October to Christmas, while from June to October the family resided at Bare in today's Blidinje Nature Park (Rajić, S., 2023). Nožnje, the area with the most fertile land in the village, was seasonally inhabited by the Karacić family from March to November. Individual Karacić families with nicknames: Soljici, Jurićići, Šudurovi, Vraninićići, and Palcušići lived in

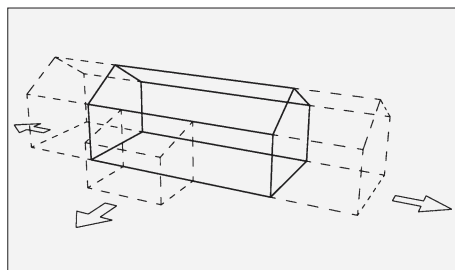


FIG. 3 SKETCH OF TYPICAL IN ROW AND PERPENDICULAR EXTENSIONS TO MAIN HOUSE VOLUME

FIG. 4 DIAGRAMMATIC SKETCHES OF THE HOUSE ELEMENTS (A), AND THE RESIDENTIAL COMPLEX (B)

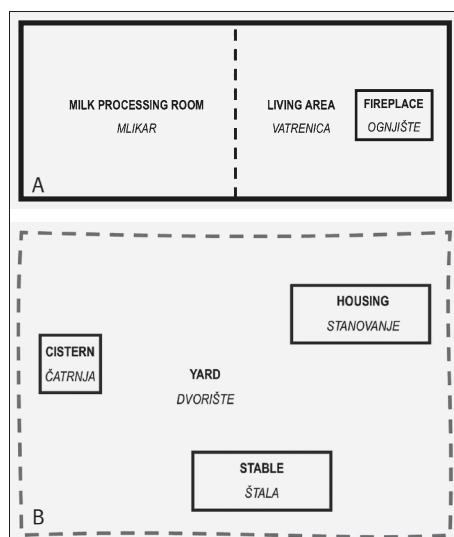


FIG. 5 A) RETAINING WALL EMBEDDED IN THE GROUND – NOŽNJE; B) SPECIFIC WALL SOLUTION WHERE THE COMPACTED SOIL LAYER IS MISSING – POD GREDA



Nožnje at the northernmost point (Rajić, M., 2023; Fig. 2). The last to leave Nožnje was Mirko Karačić – Palčusić, on 14 August 1983 (Rajić, S., 2023).

BUILDINGS

Hamlets contain residential buildings, out-buildings, auxiliary structures, and equipment, primarily constructed from stone, with wood and other materials used to lesser extent. The buildings were arranged either parallel or perpendicular to the terrain contours (Živković, 2013: 23). Herzegovinian residential architecture was marked by a one-room layout (** 2016: 16), where people lived, cooked and slept. At the center of the house was an open hearth around which the family gathered. However, examples of such houses have been preserved only in traces, found on-site as one of the rooms of an extended house. The layout was typically an elongated single-storey structure, with two main typologies: one on flat terrain and other on sloped land, where part of the house was embedded into the terrain (** 2016: 17). As families grew, additional floor or horizontal extensions were added – volumes were attached to the main volume in a row (Fig. 3) or perpendicular to the main structure (Bugarski, 1970: 147).

These added volumes were built using the same material and construction techniques. The cross-section of the house usually followed an archetypal design, with the gable roof placed on the rectangular prism. The houses were designed to withstand local weather, including wind, snow, and ice. Over time, the design developed into a two-part

residential structure, with a living area (*vatrenica*) and a milk processing area (*mlikar*) (Bugarski, 1970: 146; Fig. 4). The courtyard of the traditional Herzegovinian house in this region typically included a cistern, pergolas (often a vine-covered canopy), and greenery (Bugarski, 1970: 138). Pergolas, a common feature of the traditional Herzegovinian courtyard, were, however, absent in the surveyed area of Gornji Crnač. Review of the literature indicates that in Herzegovina there existed both open and enclosed courtyards. Open-type courtyards were without walls or fences, which enabled the interweaving of private and public spaces through the arrangement of agricultural buildings alongside residential structures (** 2016: 13). Accounts from local informants, along with field surveys, confirmed that only open-type courtyards were present within Gornji Crnač (Fig. 4b).

RESIDENTIAL BUILDINGS

Residential houses were built with stone and lime mortar. The mortar was prepared either from slaked lime and sand or from slaked lime and red soil (*crvenica*). The stone used for residential buildings was more finely worked (dressed stone), whereas for agricultural or utility structures, the workmanship was simpler and rougher (rubble stone). The walls were constructed with two outer faces made of stone blocks, while the core was filled with smaller stones, known as *sakavac* or *skalja*. The total thickness of the walls typically ranged from 50 to 80 cm (Bugarski, 1970: 151-152; Rajić, S., 2023; Karačić, P., 2023). Initially, construction employed the dry-stone technique, without any binding material. Later, hewn stone blocks were laid in lime mortar, *gnjili* (clay) or *rudaca*. *Rudaca* was produced by mixing red soil (*crvenica*) with slaked lime (Karačić, P., 2023). The first row of stones, 40 cm high and projecting at least 3 cm beyond the wall plane, was the most precisely shaped (Bugarski, 1970: 152; Karačić, M.P., 2023). The houses were typically embedded into the surrounding terrain on one or three sides (Fig. 5), and where this was not possible, an artificial embankment of earth and stone was created, known as *sopa* (Bugarski, 1970: 140). A field survey revealed a unique feature in the construction of a double wall in a residential building in the hamlet of Pod Greda, where the space between the house wall and the retaining wall was neither filled with soil nor had it ever been (Karačić, M.V., 2024; Fig. 5). The published literature does not mention this specific feature because it is difficult to detect without a detailed survey, which was not feasible due to time constraints and the large area covered.

Also, during field visits, it was observed that niches were often made in the walls of residential and outbuildings, which, according to the testimonies, served as storage for a small number of dishes and tools. In addition to the walls of houses, walls of the pens used to house livestock were also constructed. Boundary walls between individual fields were built as well, and with the rise of ownership relations, these walls known as *meda* began to define the limits of individual plots. All these walls were built using the dry-stone method (** 2016: 22). Additionally, as accounted by the six informants, the steep terrain in the hamlet of Nožnje led to the unique design for the terraces and retaining walls with stairs providing access to individual levels.

SEASONAL BUILDINGS

In seasonal buildings, the primary function was economic, with the residential function being secondary (Marković, 1971: 45). In the literature, we find that the earliest known forms of seasonal housing were single-room prefabricated wooden huts. These huts were the foundation for the development of housing which contained all the familiar architectural elements of a permanent residence, but of a more modest character (Vego, 2000: 259-272), also confirmed by two informants. The huts were dismantled during the winter months and, upon the return of the warmer season, were erected in the same or more favourable locations. The interior was typically divided into two parts (same division as in permanent buildings): *vatrenica* and *mlikar* (Karacić, P., 2023; Fig. 7). Over time, the buildings became more permanent as stays in the mountainous areas lengthened, or became permanent for some families. Informants account (Rajić, S., 2023) that, as a result, the predominantly wooden structure of the house was gradually replaced by stone, with the walls being constructed using a dry-stone method (Bugarski, 2001: 45).

BUILDING ELEMENTS

The published sources state that the floors of residential houses were most commonly made of rammed earth or clay (Bugarski, 1970: 147), which was corroborated by locals. Over time, the floors were covered with wood boards, or with stone slabs. Wood was typically used for living quarters, whereas stone, a naturally colder material, was reserved for the house's utility rooms (Karacić, P., 2023). *Gnjila* was placed in two layers beneath the hearth. The first layer consisted of clay mixed with pig hair, while the second was made of clay alone (Bugarski, 1970: 157; Rajić, S.,

2023). The clay was compacted using wooden tools, and it could last several years when made with this method (Rajić, A., 2023). In the hamlet of Pod, two households of the Ljubić family contained a *kut* (Fig. 6) – a setup of two vertical stone slabs with a horizontal one placed across them – used to collect ash from the hearth (Bugarski, 1970: 157). The survey didn't find instances of this setup anywhere else, and locals also affirmed that this element was rarely employed in the village. Also, in Nožnje, within the house of Mirko Karačić, the hearth was built into the wall – or enclosed in a manner resembling contemporary fireplaces (Rajić, T., 2023) – making this design distinctive – not previously recorded by literature, since no research was prior conducted in this hamlet.

With the advancements of the twentieth century, ground floors began to feature a thin layer of concrete (Brekalo, 2023). During this period, open hearths were often replaced by stoves called *fijaker* which were primarily used for heating, but also served for cooking and baking (Brekalo, 2023). Shortly after their introduction, they became a standard feature in the entire village. Chimneys were absent; instead, a circular opening was left in the outer gable wall. According to the informants, seasonal mountain houses, much like those in the lowlands, featured a rectangular floor plan, with a single space and a gable roof made of a wooden structure covered with rye straw. One end of the house housed a hearth, while at the other end was unheated and used for milk processing. Where present, interfloor structures were made of wood, most commonly oak and *cerovina* – a local



FIG. 6 "KUT" IN THE LJUBIĆ – POD FAMILY

FIG. 7 A) PHOTO OF THE MARKO ŠARAVANJA PREFABRICATED WOODEN HUT IN DONJE BARE; B) SKETCH OF THE TYPICAL WOODEN HUT

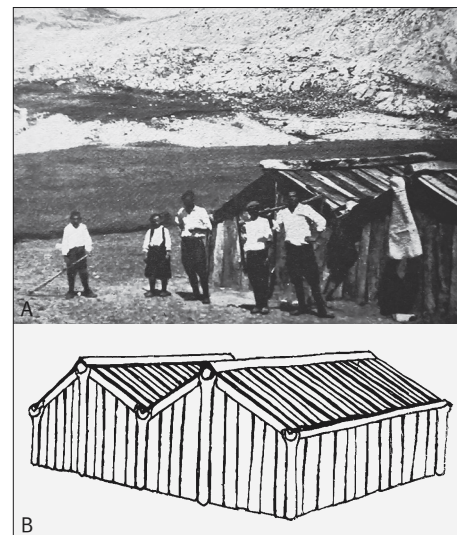


FIG. 8 ILLUSTRATION OF TWO TYPES OF CEILING:
A) BEAMS AND WOVEN BRANCHES – *LISA*;
B) BEAMS AND PLANKS ARRANGEMENT – *TRENICA*



TABLE I LINTELS
OVER WINDOWS
AND OVER DOORWAYS

Lintels over windows



Lintels over doorways

term for a type of oak (*Quercus cerris*; Karačić, P., 2023).

There were two types of wooden inter-storey structures: *trenica* and *lisa*. The term *trenica* (Fig. 8b) referred to a wooden framework composed of beams and planks. The planks were hewn with tapered cross-sections to allow them to overlap one another (Karačić, M.P., 2023). The *lisa* (Fig. 8a) was more complex to construct and produced a more porous structure, since the material was more readily available. It consisted of beams supporting wooden slats, between which *pruce* – thin branches were woven. Smoke from the ground-floor hearth would rise through the ceiling into the attic where meat was dried (Bugarski, 1970: 146; Karačić, P., 2023). This type of intermediate floor construction was

found preserved in the hamlets of Zavijana and Zagomilje.

Functionally, the houses were semi-residential and semi-economic structures (Bugarski, 2001: 18). The living space consisted of a single room with a hearth, which functioned as the main area for daily activities, including living, eating, and sleeping for the oldest members of the household – on low beds positioned on either side of the hearth. The ceiling above the unheated ground-floor *mlikar* area was constructed using wooden beams and planks (*trenica*), as were the ceilings of other unheated sections of the building. The attic also served as storage for agricultural products and, in the absence of designated bedrooms, it was used for sleeping as well (Karačić, M.P., 2023). Since wood was less



External and internal view – Zavijana



External and bottom view – Noznje



External and internal view – Noznje

available, and the length of timber was often limited, it determined the width of the house. Consequently, rooms were about 4 m wide – a dimension that persisted in later construction (Karacić, M.B., 2024).

Initially, the windows, so-called *pender*, were rather small (Rajić, A., 2023), designed to minimize heat loss during the winter and shield the interior of the house from excessive summer heat. Lintels were most commonly constructed using stone beams and vaults, with each craftsman applying his own solution; by the end of the 20th century, concrete had assumed the primary role (Naletilić, 2024). Stone window frames were crafted from local stone; however, due to their weight, they required the gathering of a large number of villagers to carry the stone from

the quarry to the construction site (Rajić, S., 2023).

The lintels were carved with greater precision than the rest of the house (Bugarski, 1970: 152). A combination of wooden and stone lintels was used less often, and one instance of this combination is still preserved in the hamlet of Pod. In the period when glass became available, window sashes had a thin wooden frame, divided into two or three panes, because glass of larger formats was too expensive. The position of the windows was determined by the internal organisation of the house and the functional requirements of each space, which is why the façades had different irregularly arranged openings (Kalajžić, 2023). Whoever had the means, installed iron bars (*demeri*) on the windows (Table I),

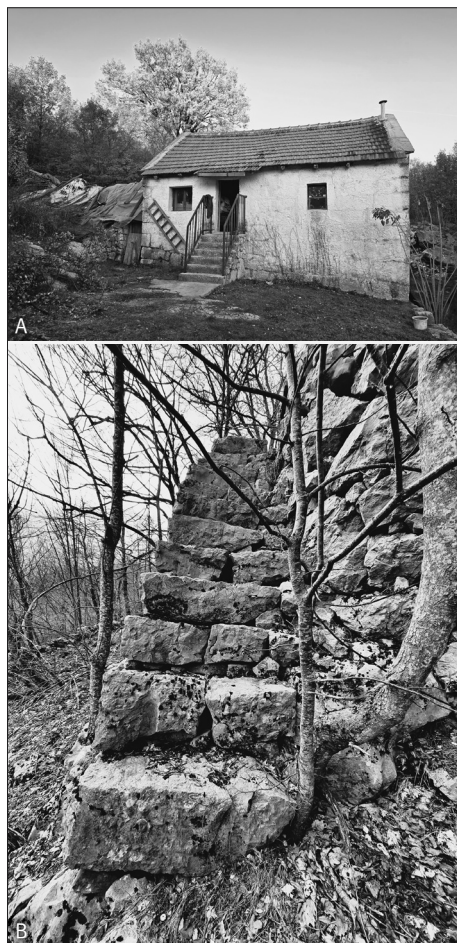


FIG. 9 A) THE FIRST HOUSE IN THE VILLAGE COVERED WITH TILES – ŽUKOVICA; B) THE LONGEST FLIGHT OF STAIRS IN THE VILLAGE – NOŽNJE

since they were the most expensive part of the house, and their manufacture required the work of a blacksmith (Karacić, M.P., 2023). The doors were made of wood, and featured two types of lintels in their design: rectangular and semicircular (***) 2016: 27; Table I). Finely-hewn blocks were used in the construction. One instance of a semicircular lintel has been preserved on the Ljubic family barn in Dobrinj; it was designed by a craftsman from the same lineage and remained in use until the 1990s (Ljubic, 2024). Apart from the rectangular and semicircular lintels, the terrain survey revealed also triangular lintels, an arched doorway, and a relieving arch as well as relieving arch above a stone lintel, and combinations of wooden and stone elements (Table I). These details varied from one master builder to another and often differed between the interior and exterior faces of the walls, reflecting the craftsmanship of different masons and suggesting the coexistence of several building traditions within the village.

The entrance door to the house was wooden, divided horizontally into two sections – an upper and a lower door. During hot days, only the upper door was opened, while the lower door remained closed to prevent animals from entering the house (Karacić, M.P., 2023).

The roof structure was built with timber, while the covering on older houses was made of stone slabs measuring 3 to 4 cm thick (Bugarski, 1970: 152; Karacić, P., 2023). They were laid diagonally with an appropriate overlap to ensure watertightness as presented in *Stara seoska stambena arhitektura u Hercegovini* (***) 1960). As stated by the four informants, it is known that the ancestral house of the Ćorić family in the hamlet of Žukovica was covered with stone slabs until 1912, when they were replaced with roof tiles (Fig. 9a), making it the first such roof in the village (Ćorić, 2024). The research found that the most common roof covering used rye straw, which remained in use by all buildings in the hamlet of Nožnje until they were abandoned (Rajić, J., 2023).

As a result, not a single roof has been preserved today. Later, in the twentieth century, roofs were covered with tiles, which lightened the roof structure and extended the life of the roof itself. Grooved tiles were more commonly used, while channel tiles were less frequent due to their more complex installation (***) 2016: 32). The published sources state that the tiles were connected with wire, but due to strong winds, they were subsequently covered with mortar along the gable and dovetail (Bugarski, 1970: 153), which

was confirmed by the informants and the preserved material evidence on-site.

Staircases, when present, were typically external, while the internal ones were generally absent (Bugarski, 1970: 156). Due to its terraced design, the hamlet of Nožnje features numerous stone steps built directly into the terrain. The residential terrace of Mirko Karacić's estate is connected to the lower terrace by a series of steep, dry-stone steps that ascend through twelve heights (Karacić, M.P., 2023; Fig. 9b). They were also the only ones to reach such height. On the shorter façades of the family house on the same estate, dry-stone steps provided access to the attic. A wooden staircase with an access terrace once stood at the Šaravanja family's two-storey house in the hamlet of Zavijana (Rajić, S., 2023). However, to this day it has only been preserved in memory of people who lived there.

WATER PROVISION STRUCTURES

Herzegovina is scarce in permanent watercourses, and therefore water provision is an integral part of every homestead. Within the hamlet there are: cisterns, rock hollows (*kamenice*), and troughs that were used to collect rainwater (Table II). First forms of cisterns were open stone cisterns, commonly referred to as "wells" in the region (*bunar*). Common to the entire area, they were recorded in the hamlets of Pod Jabuka and Žukovica (Karacić, M.B., 2024). Cisterns, vaulted structures known as *catrnje*, built adjacent to the house featured a square or rectangular design. The floor and walls were made of stone, and the cistern space was vaulted with a stone vault built on wooden formwork.

The cisterns interior surfaces were either plastered with mortar mixture of slaked lime and red soil (*crvenica*) or lined with clay to ensure water tightness (Bugarski, 1970: 169). The opening in the vault often measured 50×50 centimetres and was surrounded by four thicker interlocked stone slabs (Karacić, P., 2023). The cistern was entered through this opening for cleaning and repairs. The water used to fill the cistern was collected from the surrounding terrain and filtered. Examples of such cisterns are still preserved in the hamlets of Zavijana, Nožnje, Pod and Zagomilje. Since the inhabitants were not wealthy, they used natural resources in every segment. Thus, cisterns in the Nožnje area, if possible, were built between rocks where only two sides had to be walled off (Karacić, M.P., 2023).

The informants confirmed as claimed by the literature that *kamenice* were natural depres-

sions in the rocks used for collecting rainwater and that they were used both by shepherds and cattle during grazing (Bugarski, 1970: 169). On the other hand, the troughs were carved stone basins set beside the cistern. They were typically located in front of cisterns and houses, and they are more concentrated in the Nožnje area where a virtuous and well-known stone shaping master used to live. Later, when tin gutters were introduced, water collection from the roofs of houses began.

Cisterns started to be made of new materials, such as concrete found in the hamlets of Podi and Pod Greda. The cistern also served as a food storage space where meat could be preserved for a few days. It was lowered in a bucket on a rope into the cistern, to the zone just above the water where the temperature was lowest (Karacić, P., 2023).

OUTBUILDINGS

Outbuildings were: barns or stables, pigsties, threshing floor, chicken coops, etc. The farm complex was small and modest, only as much as was needed to meet the needs of a single family. The small buildings still fulfilled their function, because the climate was favourable and it was possible to stay outside and do the work almost all year round (Freudenreich, 1962: 205). Farm buildings were often partially buried in the ground of the sloping terrain on which they were built. The processing of stone for walls was much simpler and rougher (broken stone). The attic was most often used to store hay for livestock, but it also served as a place to sleep for the lack of proper bedrooms. If the barn was partially buried, the attic could easily be filled with hay from the upper level, and the hay was later let through the openings in the ceiling (*promet*) into the lower level where the cattle were housed (Rajić, A., 2023).

The same principles apply to seasonal housing barns. They were located near the houses, or at the foot of the hill, most often on the southern slopes (Vego, 2000: 259-272; Rajić, S., 2023). In addition, a service building *ajat* was often added to the residential structure in a horizontal extension, which, according to the literature, initially served as a shelter for livestock (Bugarski, 1970: 165-166).

However, local informants state that in their case the name and function of the same structure referred instead to the storage of goods. Within the hamlet of Nožnje and Podi, recesses were observed in the wall of the *ajat* adjoining the terrain. Inside these recesses, a hen would be placed to hatch chicks (Karacić,

TABLE II FORMS OF WATER PROVISION STRUCTURES IN GORNJI CRNAČ

Cistern in Zavijana	
	
Corner cistern (<i>cemerena catrnja</i>)	Detail of joining stone slabs of the cistern opening
Kamenicas in Zavijana	
	
Water Provision Structures in Nožnje	
	
Cistern between rocks with two sides walled	Stone trough

M.P., 2023). Chicken coops were rarely added to the residential building in the horizontal direction, on a shorter façade (Ljubic, 2024). More often, they were separated from the house and built using the dry-stone method and covered with straw. An example of a barn is still preserved on a family estate

in the hamlet of Jabuka next to the *jancijak* – a barn for lambs (Karacić, M.B., 2024). Within the complex of outbuildings there was also a circular area enclosed by a low dry-stone wall, used for threshing grain (*guvno*).

DISCUSSION

The results of this research confirm that the traditional residential architecture of Gornji Crnač is characteristic of the western Herzegovinian built heritage since it synthesizes material pragmatism and adaptability in accordance with the traditional way of life. The use of traditional building materials (stone and wood) as a design necessity that came directly from the surroundings, resulted in a recognisable architectural identity. Although simple in their construction, the buildings demonstrate a highly developed understanding of structural logic and spatial economy.

Field surveys revealed that the village's abandonment contributed to the physical conservation of its architectural authenticity. The absence of modern interventions has kept spatial and material integrity intact, protecting it from possible alterations, emphasising the importance of neglect as an unintentional mechanism of conservation. Oral accounts collected from the few remaining residents revealed unknown and valuable information raising the question of how to conserve the memory for reinterpretation of such ensembles in contemporary practice.

Moreover, several recorded construction details (such as the double wall in Pod Greda, integrated hearth in Noznje, *kut* in Pod, hatching recess in the wall in Podi and Noznje, various types of lintels, outdoor stairs, and other mentioned distinctive elements) expand the existing knowledge on Herzegovinian rural ar-

chitecture, and emphasise the creativity of local construction. They also indicate the diversity of local solutions within a seemingly uniform architectural typology, illustrating the nuances of vernacular architecture. The fact that these elements were not previously covered by the existing literature, emphasizes the importance of fieldwork as an essential complement to archival research.

More broadly speaking, this study reveals the intertwined relationships between habitation, topography, environmental cycles, material and social life as knowledge essential for preservation of both architectural and immaterial heritage of western Herzegovina.

CONCLUSION

The physical remains of the traditional architecture of Gornji Crnač reflect building technique and community that mastered construction with few immediately available materials. Modest yet sophisticated structural efficiency and spatial economy was built on the decisions that considered function, material processing, orientation, climate, and seasonal activities, achieving functionality in alignment with natural constraints.

The available literature is enriched by architectural features documented in this study, stressing the importance of field work and oral tradition. The importance of recording the design and construction techniques of the past is further stressed by the almost complete abandonment and degradation of the settlements in western Herzegovina.

Recording the memory and knowledge about vernacular heritage can ensure the continuity of western Herzegovina's architectural identity based on simplicity, functionality, material logic, and adaptability.

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SOURCES OF FIGURES AND TABLES

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| FIG. 1 | Google Earth imagery, adapted by the authors, 2025 |
| FIG. 2 | Topographic map, adapted by the au-thors, 2025 |
| FIGS. 3, 4 | Sketch of the authors, 2025 |
| FIGS. 5, 9 | Photo archives of the authors, 2023-2024, Gornji Crnač, Široki Brijeg, BiH |
| FIG. 6 | Photo archives of the authors, 2024, Gornji Crnač, Široki Brijeg, BiH |
| FIG. 7 | a) POPOVIĆ, 2008; b) BUGARSKI, 2001 |
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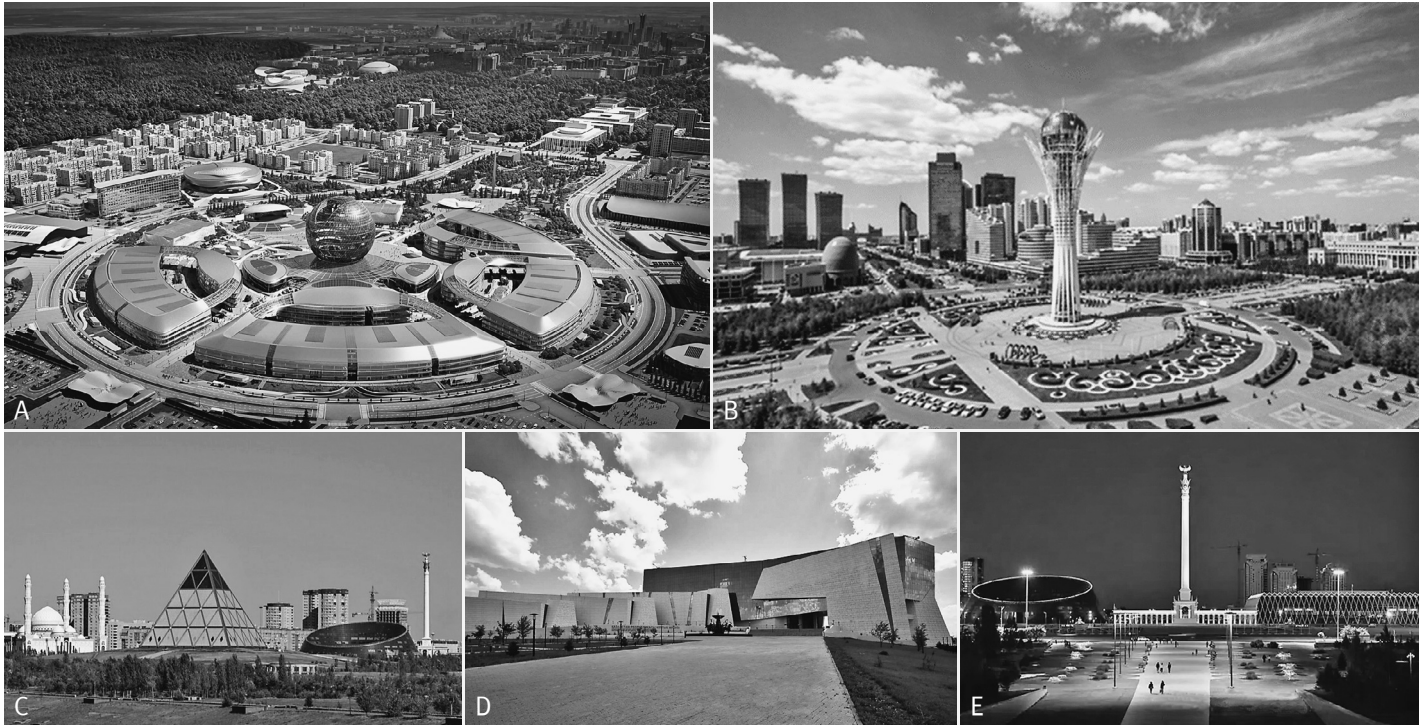


FIG. 1 MODERN LANDMARKS OF ASTANA: A) EXPO-2017, B) BAITEREK, C) PALACE OF PEACE AND RECONCILIATION, D) NATIONAL MUSEUM OF THE REPUBLIC OF KAZAKHSTAN; E) INDEPENDENCE SQUARE AND THE “KAZAKH ELY” MONUMENT



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PHILOSOPHY OF URBANIZATION AND SOCIO-CULTURAL DYNAMICS ISSUES OF A HIGH-TECH CAPITAL THE CASE OF ASTANA, KAZAKHSTAN

ASTANA, KAZAKHSTAN

DIGITAL INCLUSIVITY

PHILOSOPHY OF THE CITY

SOCIO-CULTURAL GROUPS

TECHNOLOGICAL TRANSFORMATION

URBANIZATION

The research aims to identify the impact of urbanization and technological change on the socio-cultural structure of the city. The applied methodology was based on two data sources: 1) interviews with 18 specialists from six fields; 2) a survey of 250 residents using the PREQ scale ("Perception of Residential Environment Quality"). Experts invited to participate in the research represented diverse spheres: urban planning, architecture, information technology, sociology, economics, and ecology (n = 18). The findings confirmed that technological changes in the city of Astana (Kazakhstan) contribute to its

harmonious development. Experts in urban planning, architecture, and information technology noted positive changes in urban infrastructure, visual appearance, and digital services. The results confirm that the working-age population and more vulnerable groups have different evaluations of urban environmental aspects, emphasizing the need to consider multiple perspectives in urban planning and management. The research findings are crucial for informed urban planning and the development of more inclusive and equitable urban strategies.

INTRODUCTION

In recent decades, global urbanization has taken on a rapid pace, accompanied by the integration of high technologies into urban society (Preston, 2023; Wang et al., 2021). This phenomenon not only sharpens the economic and technological aspects of urban development but also affects the socio-cultural foundations of society (Jacobs and Malpas, 2019). In the context of such changes, cities exert significant influence on the lives of their inhabitants. However, despite the evident gains in technological progress (Martin, 2019), issues related to socio-cultural dynamics require more detailed investigation. Socio-cultural changes have a substantial impact on the values, identity, and lifestyle of urban communities.

Astana, the capital of the Republic of Kazakhstan, is undergoing a process of intensive development and modernization, including advancements in high technology (Ghalib et al., 2021). As a capital city, Astana has become a place where various cultures and ethnic groups converge. Numerous modern buildings and monuments, such as Baiterek, Expo-2017, the Palace of Peace and Reconciliation, and the National Museum of the Republic of Kazakhstan (Fig. 1), have been constructed to emphasize the innovative character of the new capital (Abdrassilova and Danibekova, 2021).

At the same time, many residents of Astana still remember a time when urbanization did

not yet touch the city. Considering their experiences and knowledge, an important task is to investigate how technological transformations have affected the lives and interactions of citizens in the city, as well as to identify optimal strategies for combining high technologies with respect to cultural heritage (Manassova and Karipbaev, 2023).

LITERATURE REVIEW

Surrealism, a philosophical approach to studying the phenomenon of urbanization may have various starting points, but they all intersect in some way with the Philosophy of the City & a contemporary concept in social philosophy, based on the social dimension of urban life (Elsayed et al., 2023; Lehtinen, 2020). This area of philosophy also deals with questions about the meaning and purpose of the city, its influence on human identity, and the interaction between the individual and the urban environment (Jacobs and Malpas, 2019). Researchers (Enssle and Kabisch, 2020; Mumford, 2020) raised questions about the interplay between the city's influence and the lifestyle of its inhabitants, the formation of a sense of belonging, social relationships and individuality. The philosophy of urbanization also addresses issues of sustainable urban development (Hariram et al., 2023; Trovato, 2021). Zuziak (2020) emphasized the importance of the "meeting" of urban planning and philosophy, building a philosophical stance on the social and ecological problems of the modern city, from epistemological, ontological, and axiological perspectives of new urban policies. The philosophy of urbanization also encompasses questions of cultural identity in cities. Researchers (Ragheb et al., 2022; Theodora, 2020) are interested in how cities preserve their cultural heritage and how they adapt to and integrate new elements into their cultural background.

The study of transformations in large urban centres brings together three distinct disciplines: urban sociology, cultural anthropology, and ecological urbanism. Evaluation methods integrate measurable infrastructural data with residents' subjective assessments (Mouratidis, 2021). The spatial distribution of urban facilities directly affects social cohesion, as the degree of street connectivity determines the frequency of encounters among individuals from different social groups (Medeuov, 2021).

This interplay has resulted in a new conceptualization of urban space. The legacy of the Soviet past continues to shape urban development, as administrative structures often persist even after formal political reforms

(Kinossian, 2022; Ranjan, 2023). In Kazakhstan, where more than 130 ethnic groups co-exist and communicate in diverse languages, research methodologies must be sensitive to cultural heterogeneity. Moreover, urban development faces tensions between state planning priorities and market-driven interests, producing a juxtaposition of grand boulevards with irregular, unregulated construction (Gerten et al., 2022).

Western theoretical frameworks require adaptation to local contexts. Soviet-era standardized housing, centralized heating systems, and public services continue to influence residents' everyday practices. Assessments of urban quality must also account for unequal access to services among the elderly, low-income populations, and individuals who do not speak the state language. Collectively, these factors signify a fundamental reorientation in approaches to urban research.

With the development of technologies and smart city concepts, researchers (Cugurullo, 2021; Epting, 2021) also consider the ethical and philosophical aspects of technology integration into the urban environment. The working-age population typically utilizes technology more actively and may assess its impact and the quality of the urban environment differently from less affluent segments of the population (Song et al., 2020). Socio-cultural factors such as age, financial status, ethnic background, and the presence of limited capabilities may affect the assessment of urban environment quality (Chakraborty et al., 2020; Raiden and King, 2021). Therefore, the second research hypothesis suggests that significant differences exist in the perception of urban environment quality among different socio-cultural groups in the context of Astana (H2). The study aims to identify the influence of technological transformations in the context of urbanization on the socio-cultural dynamics of the high-tech capital, with a focus on the case of Astana.

The philosophical perspective links the practical evaluation of the urban environment with the theoretical analysis of cultural transformation. The examination of individuals' lived experiences reveals the realities that lie beyond statistical indicators, as perceptions of urban space are shaped by cultural background. This orientation has determined the choice of research methodology.

METHODOLOGY

• **Research design** – The study combined both qualitative and quantitative analysis (Fig. 2). Experts from six disciplines – urban planning, architecture, information technolo-



FIG. 2 RESEARCH DESIGN SCHEME

gy, sociology, economics, and ecology – provided assessments during in-depth interviews, with their professional perspectives being compared to the opinions of survey respondents. City residents completed questionnaires using the PREQ scale, with a total of 250 participants. This two-tiered approach allows for a comparison between professional judgments and the real-life perceptions of various sociocultural groups regarding the urban environment.

In the context of digital inclusivity, researchers have identified several population groups that are more likely to encounter challenges in accessing digital technologies and digital literacy: elderly individuals, economically disadvantaged populations, people with limited abilities, low-skilled workers, and ethnic minorities.

• **Participants** – The expert sample comprised (1) specialists in urban planning, (2) architecture and design, (3) information technology, (4) sociology, and (5) economics and business, ecology, and sustainable development. Three individuals were invited for each domain. Experts were selected according to the following criteria: at least five years of professional experience, completed projects or scholarly publications on Astana, and demonstrated knowledge of local specificities. Recruitment was carried out through referrals from colleagues affiliated with professional associations and universities. Ultimately, the sample comprised eleven practitioners and seven researchers. Thus, the expert sample consisted of 18 individuals, 10 males and 8 females. The average age of participants was 44 years, with an average work experience of 16.9 years. The demographic data of the participants are presented in Table I.

The local population sample consisted of two groups of participants, who, according to the researchers, may experience varying levels of access to digital technologies and digital literacy: the working-age population aged 25-60 (Group A) (n = 126) and the elderly, eco-

TABLE I DEMOGRAPHIC DATA OF EXPERT SAMPLE

Specialization	Names	Sex	Age	Years of experience
Urban Planning	Daneesh	M	44	21
	Diana	F	38	12
	Zara	F	34	8
Architecture and Design	Anna	F	45	7
	Rustem	M	39	14
	Timur	M	55	21
Information Technology	Amir	M	37	11
	Sania	F	51	24
	Taiyr	M	66	41
Sociology	Leyla	F	58	16
	Olga	F	32	7
	Mustafa	M	44	19
Economics and Business	Alexander	M	49	26
	Gyuzel	F	39	13
	Daniyar	M	35	14
Ecology and Sustainable Development	Vasily	M	50	28
	Zhanazar	F	41	16
	Timofey	M	34	6

TABLE II DEMOGRAPHIC DATA OF THE LOCAL POPULATION SAMPLE			
		Group A	Group B
		n	n
Sex			
	Male	59	60
	Female	67	64
Age			
	18-29	31	27
	30-44	43	29
	45-59	36	19
	Older than 60	16	49
Education Level			
	Secondary	42	42
	Bachelor's	59	63
	Master's and above	25	19

nomically disadvantaged segments of the population, individuals with disabilities, low-skilled workers, and representatives of ethnic minorities (Group B) (n = 124). The demographic data of the local population sample are presented in Table II.

In both groups, there is a balanced number of men and women. The average age of participants in Group B is 52.6 years, while that of Group A is 44.2 years. Group B includes a larger number of elderly individuals (aged over 60) compared to Group A.

• **Procedure** – Interviews with experts were conducted by researchers either in person or through video conferencing tools. Experts were invited through open sources or personal channels of communication of the researchers. Participation of experts was voluntary. In order to maintain anonymity, the names of the experts were changed. The interview for each category of specialist concerned their vision of the impact of technology on the development of the city in relation to their area of expertise.

Residents completed self-report questionnaires using the Perceived Residential Environment Quality (PREQ) scales (Fornara et al., 2010). For Group A, a representative sample was drawn from various districts of the city, considering diversity in socio-economic and demographic parameters. This involved

random selection of houses, neighbourhoods, and workplaces, but with consideration for age and employment status. For Group B, the sample was based on data from social services, support centres, charitable organizations, and other institutions working with representatives of this category.

• **The assessment scales** – PREQ consists of 11 scales, totalling 66 items. Each scale comprises items with both positive and negative formulations. Responses were provided on a scale ranging from 1 = strongly disagree to 7 = strongly agree. The structure and reliability of the PREQ scales are presented in Table III.

• **Data analysis** – The first hypothesis (H1) was formulated: technologies contribute to the development of the city as a unified social space. To test this assumption, interviews with experts were conducted, and the responses were analysed using content analysis. This involved converting the interview recordings into text format, identifying categories for content analysis based on key themes (urban planning, architecture, information technology, etc.), coding the interview text, analysing patterns, and assessing the consistency of opinions among experts.

To test the hypothesis that there are significant differences in the perception of urban environment quality among different socio-cultural groups (H2), an independent t-test was used. Using the t-test, the survey results were compared between two groups: the working-age population aged 25-60 (Group A) and more vulnerable sociocultural groups, including the elderly, low-income populations, people with disabilities, low-skilled workers, and ethnic minorities (Group B).

The analysis was conducted in three stages, progressing from specific observations to broader conclusions. At the first stage, 247 individual ideas were extracted from the interview transcripts. At the second stage, these ideas were grouped into 31 categories through comparative analysis. At the third stage, eight overarching themes were identified concerning the relationship between technologies and social stratification.

This process led to a breakthrough in understanding the problem. The interview results were cross-validated with numerical data from the PREQ surveys to ensure the robustness of the findings. The experts highlighted differences across population groups. Practitioners pointed to challenges with digital technologies among individuals over the age of 60 (correlation with “Accessibility Organization,” d = -0.417), while sociologists emphasized the influence of economic stratification on service utilization (correlation with “Commercial Services,” d = -0.515).

TABLE III STRUCTURE AND RELIABILITY OF PREQ SCALES			
Scale	Categories	Number of Items	Cronbach's Alpha
Architectural and Urban Planning Space	Building Aesthetics	3	0.78
	Building Density	3	
	Building Volume	3	
Organization of Accessibility and Roads	Internal Functionality	3	0.81
	External Connections	3	
Green Areas		4	0.75
Social Relational Features	Security	3	0.86
	Discretion	3	
	Sociability	3	
Welfare Services	School Services	3	0.81
	Social Care Services	3	
Recreational Services	Sport Services	3	0.74
	Social-Cultural Activities	3	
Commercial Services		4	0.79
Transport Services		4	0.85
Pace of Life	Relaxing Versus Distressing	3	0.76
	Stimulating Versus Boring	3	
Environmental Health		4	0.80
Upkeep	Macroupkeep	4	0.82
	Microupkeep	4	

• **Ethical issues** – All participants provided consent to participate. Anonymity was guaranteed to participants, and personal data were neither collected nor stored. Participation in the study was voluntary. The names of experts were changed, and no remuneration was provided.

• **Limitations** – The study has several limitations that should be acknowledged. The survey included only 250 residents and 18 experts from a single city, which may restrict the generalizability of the findings to other urban contexts in Kazakhstan. While the sample size was sufficient to identify trends, a larger participant pool is required to draw definitive conclusions. Although the experts represented diverse professional domains, perspectives from peripheral areas were underrepresented.

In addition to the main findings, the study revealed methodological challenges. Conducted at a single point in time, the research design does not allow for a precise determination of whether technologies directly caused the observed social changes; longitudinal observation would be necessary to establish causality. Furthermore, the PREQ questionnaire captures individuals' perceptions, which may diverge from actual conditions.

Future research should, therefore, pursue longitudinal studies with consistent participant groups, integrate sensor-based data to validate survey responses, and extend the analysis to other cities such as Almaty, Shymkent, and beyond.

RESULTS

TECHNOLOGICAL TRANSFORMATIONS AMID URBANIZATION WILL CONTRIBUTE TO THE HARMONIOUS DEVELOPMENT OF THE CITY AS A SOCIO-CULTURAL SPACE (H1)

The responses of urban planning specialists to questions about changes in the urban environment, infrastructure, and overall city composition resulting from technological changes generally reflect positive developments associated with technological innovations in Astana.

"Technological changes have led to the modernization of urban infrastructure. The implementation of efficient traffic light systems, the development of digital city maps, and digital schedules for public transportation have made the infrastructure more resilient and adaptive to the needs of citizens." (Diana)

"The city has transformed, acquiring a modern appearance." (Danesh)

Among the areas for improvement, all three experts unanimously recommend improving

public transportation, accelerating the implementation of electronic tickets for public transport, and enhancing the safety of pedestrians and cyclists. Two out of three experts also emphasized the need to expand urban spaces for socializing and recreation:

"Innovative urban parks with modern art design for family leisure – that's exactly what, in my opinion, Astana lacks." (Zara)

Experts in architecture and design, like urban planning specialists, also noted that the city's external appearance has only improved in recent years.

"Light installations, digital building facades, and the use of next-generation materials create unique visual elements." (Timur)

At the same time, each of the experts in architecture and design had their own recommendations for improvement.

"I recommend paying attention to the use of 'smart' materials in the city's architecture, which is currently practiced very rarely as far as I know. Such materials can react to changes in the environment, adapting to various conditions, such as severe frost or strong winds. This will not only increase the efficiency of buildings but also create unique forms and textures that harmoniously blend with the technological spirit of Astana." (Rustem)

"Old factories can be transformed into modern cultural centres, while preserving elements of industrial design." (Timur)

Experts in the field of information technology spoke about the advantages of digital infrastructure, smart technologies, and the optimization of urban systems in the context of urban life in Astana and emphasized the importance of involving the wider public in the process of digital transformation.

"The direction of development of digital infrastructure in Astana is chosen correctly, but further strengthening is necessary." (Sania)

"It is important to conduct educational programs on the use of digital technologies, as well as actively engage with the community to gather feedback and suggestions." (Amir)

Sociology specialists noted new opportunities for obtaining information, communication, and entertainment.

"First and foremost, I can mention modern media and social networks as new means of communication and cultural exchange." (Olga)

At the same time, the aspect of digital accessibility and inclusivity was emphasized:

"There is a problem that elderly people cannot actively use technologies, and this creates a certain social imbalance. It is neces-

TABLE IV DESCRIPTIVE STATISTICS AND INDEPENDENT T-TEST RESULTS BETWEEN GROUP A AND GROUP B								
	Group A		Group B*		t	p	d	95% CI (Lower - Upper)
	M	SD	M	SD				
Architectural and Urban Planning Space	3.77	0.75	3.82	0.88	0.84	0.805	0.061	-0.187 – 0.309
Organization of Accessibility and Roads	3.11	0.78	2.77	0.85	5.96	0.033*	-0.417	-0.668 – -0.166
Green Areas	3.19	0.82	3.23	0.75	0.79	0.712	0.051	-0.197 – 0.299
Social Relational Features	3.23	0.76	3.04	0.82	1.30	0.061	-0.228	-0.476 – 0.021
Welfare Services	3.25	0.78	3.01	0.62	3.07	0.045*	-0.34	-0.59 – -0.091
Recreational Services	3.39	0.74	3.56	0.81	1.44	0.066	0.219	0.029 – 0.468
Commercial Services	3.52	0.66	3.12	0.88	6.17	0.028*	-0.515	-0.767 – -0.263
Transport Services	3.20	0.74	3.05	0.78	1.38	0.09	-0.197	-0.446 – 0.051
Pace of Life	3.46	0.68	2.87	0.69	7.79	0.01*	-0.861	-1.121 – -0.602
Environmental Health	3.31	0.77	3.28	0.73	1.06	0.707	-0.04	-0.288 – 0.208
Upkeep	3.21	0.54	3.77	0.68	8.96	0.001*	0.913	0.652 – 1.173

* p < .05

TABLE V ALIGNMENT BETWEEN EXPERT ASSESSMENTS AND PUBLIC PERCEPTIONS		
Expert Theme	Corresponding PREQ Scale	Difference between groups (Cohen's d)
Digital Infrastructure (IT experts)	Accessibility Organization	-0.417*
Technological Inclusiveness (Sociologists)	Commercial Services	-0.515*
Pace of Modernization (Urban Planners)	Pace of Life	-0.861*
Ecological Innovations (Environmental Scientists)	Environmental Health	-0.040

sary to assess how accessible technologies are for all layers of the population and what barriers exist for certain groups. This is important to ensure equal opportunities and prevent possible socio-cultural inequalities.” (Mustafa)

Economists and entrepreneurs focused on the economic efficiency of innovations and improvements in the functioning of the business environment.

“I can note the improvement of production processes, logistics optimization, as well as the use of technologies for data analysis.” (Alexander)

“Simplified procedures for registration and licensing support for innovative projects through tax incentives – these are the main improvements that I have noticed.” (Daniyar)

Recommendations for improvement included funding for innovation (“Availability of additional investments and grants for startups”, Alexander) and strengthening the training and development system for personnel (“Support for educational programs in the field of innovation”, Gyuzel).

Ecologists and specialists in sustainable development noted new opportunities for monitoring the environmental situation in the city and energy conservation.

“Sensors and remote sensing systems collect data on air, water, and soil quality; residents can access pollution data using their smartphones.” (Zhanazar)

“Solar panels, wind turbines, and other renewable energy sources contribute to the transition to clean energy.” (Timofey)

Among the proposals, there were innovative methods of waste management, the development of electric transportation, and the promotion of eco-technologies implementation in enterprises.

AMONG DIFFERENT SOCIO-CULTURAL GROUPS, SIGNIFICANT DIFFERENCES EXIST IN THE PERCEPTION OF URBAN ENVIRONMENT QUALITY (H2)

According to the results of statistical analysis (Table IV), regarding the Architectural and Urban Planning Space, Green Areas, Social Relational Features scales, Recreational Services, Transport Services, Environmental Health the ratings between the two groups are *similar*, with statistically insignificant differences. Group A evaluates the Organization of Accessibility and Roads, Welfare Services, Commercial Services, Pace of Life and Upkeep higher than Group B, and the differences are statistically significant, with a medium effect size ($d = -0.417$), small effect size ($d = -0.34$), noticeable effect size ($d = -0.515$), strong effect size ($d = -0.861$) and the strongest effect size observed ($d = 0.913$) accordingly.

The comparison of expert interviews with survey statistics revealed consistent patterns (Table V). Concerns were raised regarding the exclusion of certain groups from digital life. The statistical analysis confirmed these concerns: population groups differed significantly in their assessments of the accessibility of urban services ($d = -0.417$, $p < 0.05$) and commercial services ($d = -0.515$, $p < 0.05$). Modernization also affects population groups unevenly, most notably reflected in the “Pace of Life” indicator ($d = -0.861$).

DISCUSSION

Experts from different fields concur that technologies contribute to Astana’s development. This finding supports the research hypothesis (H1). At the same time, insights from the experiences of other countries were also identified. The results also indicated significant differences in the perception of the urban environment between the working-age population and more vulnerable socio-cultural groups. This reflects the concept of urban philosophy as a place where not only structures and technologies interact but also di-

verse socio-cultural contexts (Jacobs and Malpas, 2019). The obtained results draw attention to digital divides among different population groups. This aligns with urbanistic philosophy, which asserts that the urban environment, its resources, and amenities should be accessible for use by all segments of society, regardless of their social status, age, physical abilities, and other characteristics (Hariram et al., 2023; Trovato, 2021). The results indicating differences in the assessment of parameters such as “Pace of Life” and “Upkeep” suggest that urbanization changes affect the perception of quality of life by different groups. This serves as a cautionary note that urbanization is not uniformly perceived by all population strata.

Research conducted in various countries reflects the diversity of the impact of technological changes and urbanization on socio-cultural dynamics. In Singapore and Atlanta (USA), technologies are widely utilized to create smart cities (Johnston, 2019). In Indian cities such as Bangalore and Hyderabad, the rapid development of technological innovations, especially in the field of information technology, affects urban culture by facilitating communication and access to services (Subrahmanya, 2017). Nairobi (Kenya) demonstrates how technological changes, such as mobile payments, impact economic and socio-cultural spheres, improve financial inclusion and alter lifestyles (Wong et al., 2023). São Paulo in Brazil also undergoes technological transformations, influencing transportation, education, and interaction with urban infrastructure (da Silva et al., 2020). Thus, in Kazakhstan and several other countries with different typologies of economic development, technological changes are accompanied by various challenges and opportunities, and socio-cultural aspects are influenced by innovations depending on the context of economic development and cultural characteristics.

The experience of digitalization in European cities offers valuable lessons for Astana, with many solutions that can be adapted to local conditions. European practices provide benchmarks for urban development. In Barcelona, for example, the Decidim platform enables citizen participation in urban governance, with 31,259 registered users. However, the ambitious promises of authorities are not always realized in practice (Alizadeh et al., 2024). In Copenhagen, 98% of buildings are connected to district heating, a system that reuses waste heat and is managed through digital technologies. This model is particularly relevant for Astana, where temperatures fluctuate between -40°C in winter and $+35^{\circ}\text{C}$ in summer (Maliszewska-Nienar-

towicz et al., 2024). In Vienna, 60% of residents live in municipal housing. The city continues to modernize technologies while maintaining affordable housing prices, successfully combining social policy with innovation (Felt and Sepehr, 2024). The European “New Bauhaus” program defines specific urban development goals, allocating 15% of the budget to green areas, converting 80% of abandoned industrial sites into usable spaces, and ensuring that all basic services are accessible within a 15-minute walk (Rosado-García et al., 2021).

Astana, however, has its own particularities: sharp temperature fluctuations, a complex urban layout consisting of nearly 80,000 plots, and a multiethnic population. European experiences must therefore be carefully selected and adapted, as direct imitation is unlikely to succeed. The legacy of the Soviet period remains evident in large residential blocks and district heating, while administrative systems have inherited Soviet operational principles. These structural features continue to shape the implementation of new technologies in the city (Sandu, 2024).

CONCLUSIONS, RECOMMENDATIONS, AND PROSPECTS FOR FURTHER RESEARCH

The study has certain limitations, namely a small sample size and a focus on a single city. Within these constraints, however, the findings highlight the need for targeted support for the elderly population. This includes the provision of accessible sidewalks and resting benches, as well as improving the availability of public services for older citizens. Continuing to develop digital infrastructure to enhance citizens' quality of life, including mobile applications and digital services, is recommended, as well as expanding the use of eco-technologies. The preliminary findings outline tasks for urban planners and architects. These conclusions remain tentative and require further validation. To ensure reliability, a larger research sample is necessary. Comparative analysis with other cities – such as Almaty, Shymkent, and regional centres – will strengthen the evidence base. Incorporating diverse urban contexts will also allow for testing the universality of the identified patterns. Future researchers can focus on conducting additional statistical tests to identify more detailed differences in the perception of the urban environment among sociocultural groups. Expanding the study to other high-tech capitals can provide a comparative analysis and more general conclusions about the impact of technological transformations on sociocultural dynamics in cities.

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SOURCES OF FIGURES AND TABLES

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- TABLES I, II Compiled by the authors
- TABLE III Developed by the authors based on FORNARA et al., 2010
- TABLES IV, V Developed by the authors

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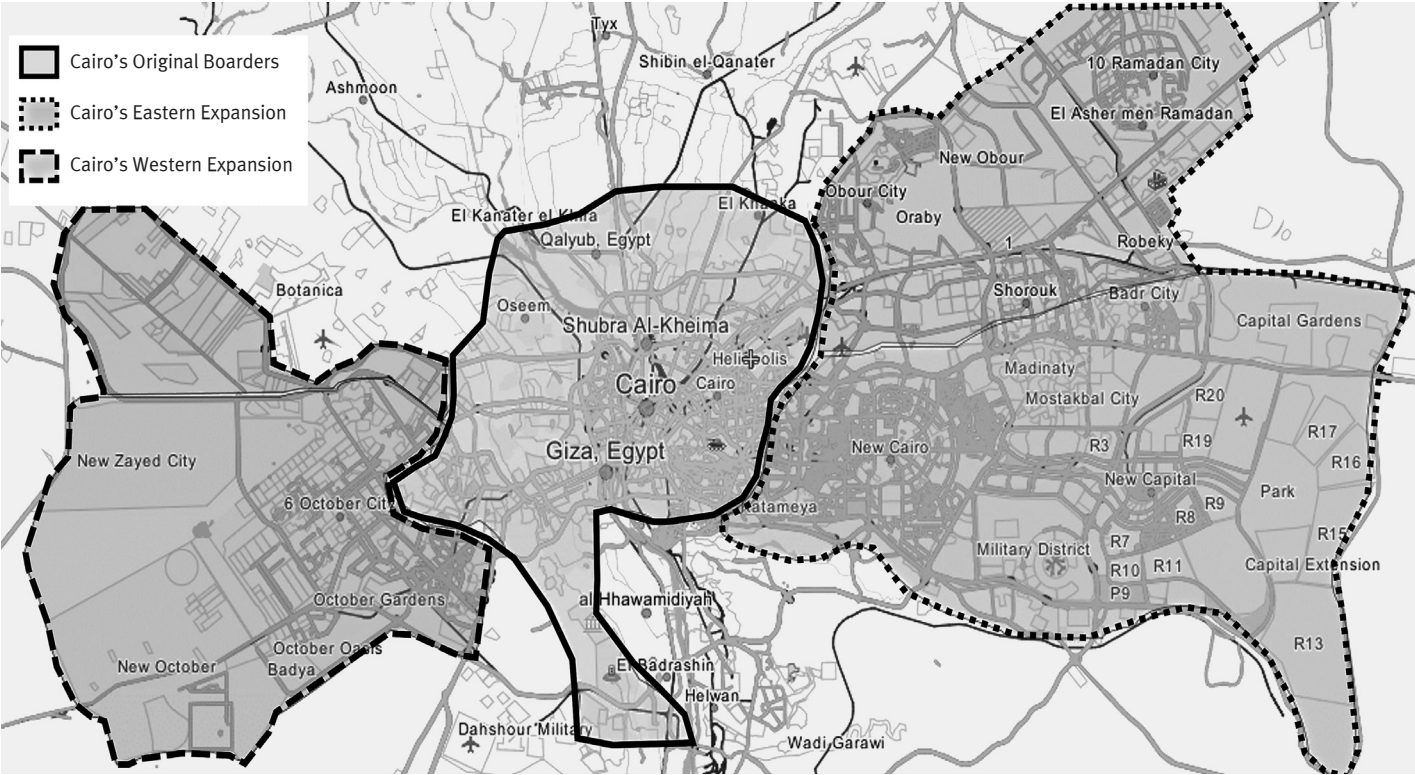


FIG. 1 THE NEW GATED COMMUNITIES FLOURISHING INSIDE CAIRO AND ITS URBAN FRINGE NEW TOWNS



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LOCALIZING SOCIAL ASPECTS AND LIVEABILITY CRITERIA IN NEIGHBOURHOOD SUSTAINABILITY ASSESSMENT TOOLS CASE STUDY: NEW URBAN EXPANSIONS IN CAIRO, EGYPT

LIVEABILITY
NEIGHBOURHOOD SUSTAINABILITY ASSESSMENT TOOLS (NSATs)
NEW COMMUNITIES
SOCIAL SUSTAINABILITY
URBAN REGENERATION

Successful urban regeneration accentuates the major purpose of the built environment in achieving urban renewal, in particular preserving local identity and sense of place, promoting mixed-use communal living, and optimizing resources on a long-term plan. The city of Cairo, Egypt, has witnessed a significant urban growth, with new cities located in the urban fringe. However, it is questionable whether the neighbourhoods located in the new expansions are regenerative and sustainable as claimed. Evaluating new neighbourhoods' performance helps in improving the built environment as enhancing their liveability and sustainability significantly contributes to better regenerative urban environments. This study tackles the issue of evaluating new

Egyptian neighbourhoods' sustainability. An extensive analysis was carried out for three Neighbourhood Sustainability Assessment Tools (NSAT), LEED®ND, BREEAM Communities and CASBEE-UD, to address the most applicable one to the Egyptian context. The research showed that 1) the social dimension was poorly addressed together with 2) the difficulty of applying the tool in the Egyptian context, as it has different cultural and demographic characteristics. The research highlights the importance of addressing neighbourhood liveability in NSATs as well as the need for their adaptation to local context. This represents a solid foundation for future research and creating NSATs adapted to the Egyptian cultural context.

INTRODUCTION

Urban expansions have emerged as a result of specific human needs expressed by groups of people in a certain area, personal preferences, climatic changes, cultural backgrounds, economic pursuits, political or religious factors, etc (Keleg, 2015: 15). A wide range of new urban expansions worldwide are being planned and developed on a massive scale, yet previous experiences from all over the world proved to be a failure for some of those new communities' social structure (Azzam, 2017: 20). Therefore, there is a crucial need to adopt a strong perception and dedication to designing socially successful as well as economically and environmentally sustainable cities (Woodcraft et al., 2011: 16)

It is thought that expansion has neglected some local values in several new communities and the promotion of environmental quality within others. The newly developed urban environment in Cairo, Egypt often lacks vital aspects of sustainability, and environmental and humane qualities. The focus has been on economic development, leading to the creation of mass-produced housing environments (Nasr et al., 2023: 1).

In general, many new communities might have failed in meeting some crucial needs and preferences of the residents. One of the most influential pillars for achieving any country's urban sustainability is a socially sustainable neighbourhood, however, the

term "neighbourhood social sustainability" is challenging and does not clearly exist in the social and sustainable urban development literature (Azzam, 2017: 25).

Limited studies have been conducted related to this topic in the Egyptian context. Consequently, neighbourhood sustainability is not as well illustrated and understood as in western literature. Therefore, this paper aims to investigate the ability to assess the performance of new expansions through detecting which of the existing tools are applicable for assessing the sustainability of the neighbourhood in the Egyptian context, with a special emphasis on social aspects and liveability. This contribution represents an initial phase of a broader research endeavour. It aims to establish the foundational principles and articulate the relevance of the subject matter, thereby setting the stage for subsequent investigations. The paper also elucidates the methodological approach that will guide the comprehensive research, leading to the development and adaptation of a neighbourhood sustainability assessment tool tailored to the Egyptian context.

OVERVIEW OF THE RESEARCH CONTEXT

The great city of Cairo's built-up area consists of three main sectors. The major one is the city of "Cairo" located on the east bank of the Nile, extending from Shubra in the North to Helwan in the South, and Heliopolis and Nasr City in the northeast. The second sector is "Giza" governorate lying on the west bank of the Nile, and finally "Al-Qualiubya" governorate located in the north of Cairo (Fahmi, Sutton, 2008: 279). In the period between 1980s and early 2000s, Cairo experienced a surge in urban expansion and development driven by government-led initiatives to accommodate a growing population and stimulate economic growth such as the 1st district established in 1985 and Jasmine in 2000 according to (Ghonimi, 2022: 3) as shown in Table I. This period witnessed the creation of new urban communities on the city's fringes, characterized by modern housing complexes, planned infrastructure, and amenities designed to attract middle and upper-income residents (Fahmi, Sutton, 2008: 281). The aim of these developments was to improve housing shortages, upgrade living standards, and promote sustainable urbanization.

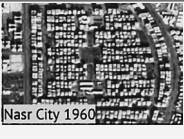
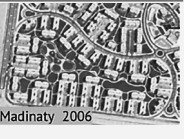
Despite the efforts to establish well-planned new communities, the low-income residents faced several issues concerning the affordability, accessibility, and social integration. Consequently, the informal settlements, known as "Ashwa'eyat" issue has not been solved and kept expanding, causing challenges to urban

planning and governance (Singerman, Amar, 2009: 32). The way those settlements function often led to inadequate infrastructure, lack of basic services, and vulnerability to displacement and social exclusion.

Cairo has witnessed neglect of old neighbourhoods, characterised by rich cultural heritage and historical precedence in the past few decades, being favourably disposed to the construction of new urban expansions. This has resulted in profound consequences on the social cohesion, identity, and liveability of the city. The establishment of new urban expansions on Cairo's urban fringe shown in Fig. 1 has mainly favoured specific social groups, particularly middle and upper-income class (Akl, 2022: 6). These new urban expansions, often known as gated communities, offer progressive amenities, well designed infrastructure, and security services designed to fulfil the needs and preferences of high-class residents.

Neighbourhoods act as an important tool for the investigation and planning of municipal areas (Leby, Hashim, 2010: 69). They are the fundamental building units forming cities letting planners experiment with approaches and development scenarios for improving their quality (Rohe, 2009: 210). The contemporary European discourse on sustainability, particularly within the European Union, increasingly acknowledges the critical role of social sustainability and community development. This trend is evidenced by the emergence of initiatives such as the New European Bauhaus and the 15-minute city concept, which, along with the theoretical and practical contributions of Jan Gehl (2010), advocate for the creation of sustainable and inclusive urban spaces. These frameworks prioritize the community as the central focus of urban design, aiming to cultivate environments that foster individual satisfaction, innovation, and creativity. Governments have usually divided the city into sectors to secure a fair distribution of resources and services. Over the past three decades, several studies have tackled the new urban expansions in Cairo, Egypt. The traditional neighbourhood's spatial configuration has undergone significant transformations influenced by rapid urbanization, population growth, economic development, and changing social dynamics (Stewart et al., 2004: 97). Although neighbourhood planning dates back to long time ago, urban planners and specialists in principle didn't consider the evaluation of its performance and sustainability until the beginning of the 21st Century (Sharifi et al., 2021: 2).

All these factors imply the need for empowering social sustainability components and liveability in planning and regenerating new

TABLE I CLASSIFICATION OF NEIGHBOURHOOD TYPES IN CAIRO SINCE THE EARLY 20 TH CENTURY				
Neighbourhood Type	Early Developed (Traditional)	Early Planned	New Planned	Contemporary Private
Examples	 Abasiaa 1850	 Nasr City 1960	 1 st District 1985	 Madinaty 2006
	 Shoubra 1850	 Heliopolis 1900	 Jasmine 2000	 Mivida 2022
Public spaces Morphology	Streets as public spaces	Urban space as fenced islands	Urban spaces as open islands	Urban spaces inside the superblocks
Date	Early 20 th Century	Early and mid-20 th century	1980-2000	2000-current
Developer	Over agricultural land	Government Private Developers	Government	Private Developers

Egyptian neighbourhoods, indicating a lack of complete and adapted assessment tools for the task.

SUSTAINABLE URBAN ENVIRONMENTS

Regenerative urban environments are entrusted to provide sustainable economic, environmental, and social aspects – the three main pillars of sustainability – for current and future generations; it depends on those environments' performance to ensure that community perform well. On the other hand, liveability and the quality of life is concerned with residents' current satisfaction with the community they live in (Ghonimi, 2022: 3). This research prioritizes social sustainability, one of the three pillars, due to the existing overemphasis on economic and environmental aspects in urban development. Economic considerations dominate development practices, and current sustainability assessment tools largely address environmental concerns. Consequently, social sustainability criteria are often overlooked and represent the main motivation for this research.

The concept of sustainability and liveability emerged in the last half of the 20th century, and they are two important drivers for the early 21st century's city planning vision even if the community or neighbourhood concept has been known as playing an important role in city formation. The three concepts have so much in common, overlapping each other, and several similarities could be found among their criteria. Although each concept has its special criteria and addresses some defined issues in a thoughtful manner, the way it is applied is similar to a specific extent (Zarin, Tarantash, 2011: 2).

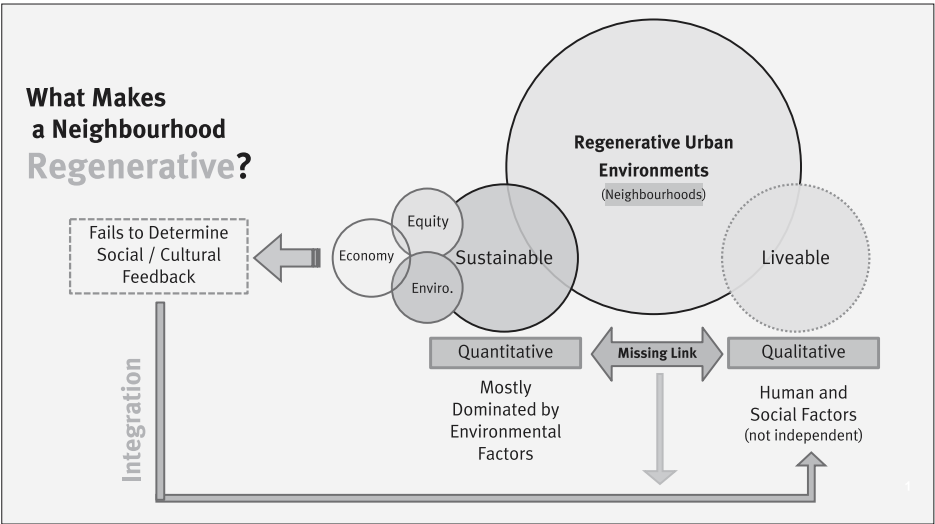


FIG. 2 THE RELATION BETWEEN THE FACTORS AFFECTING THE PRODUCTION OF REGENERATIVE URBAN ENVIRONMENTS

Neglecting the sustainability indicators in favor of assuring residents' satisfaction and applying quality-of-life solely may be associated with negative impacts and consequently the community could fail in serving the residents properly, even if it is characterized by a high quality of life (Porio, 2015: 246). In this circumstance, achieving urban sustainability results in dissatisfaction as residents and practitioners ignore applying it. Moreover, increasing the quality-of-life prompts economic and resource consumption, and social exclusion, leading to devalued sustainability (Nikoofam, Mobaraki, 2020: 863). Therefore, it is important to bridge the gap between the achievement of quality-of-life in urban environments and assuring their sustainability socially, economically, and environmentally

as explained in Fig. 2. In other words, address how communities apply sustainability aspects and simultaneously provide high quality-of-life and satisfaction for their residents.

THE CONCEPT OF LIVEABILITY

Liveability could be described as a result of interaction between the community and the surrounding environment, while focusing on the residents' evaluation of this environment (Shafer et al., 2000: 165; Leby, Hashim, 2010: 71). It embodies dwelling's elements, neighbourhoods and municipal areas that provide security and safety, economic opportunities, health, accessibility, walkability and recreation (Jarvis, Young, 2005). According to Leby and Hashim (2010: 72), liveability does not only appertain to residential units and urban qualities, but it is also concerned with the communities' quality of life. According to Kasim et al. (2020) liveability is addressed as a composite of interconnected social, economic, and ecological values that promote and enhance quality of life and sustainability. Also, it signifies the challenges to the lifestyle of individuals and communities.

Neighbourhoods are places where people live, interact, and spend their time. Also, inhabitants are more concerned with neighbourhoods as what happens there affects their quality of life and, for some business owners it affects their financial standing. Therefore, stakeholders and urban planners have to consider neighbourhoods as an important physical and social unit for managing urban planning challenges (Parker et al., 2023: 14).

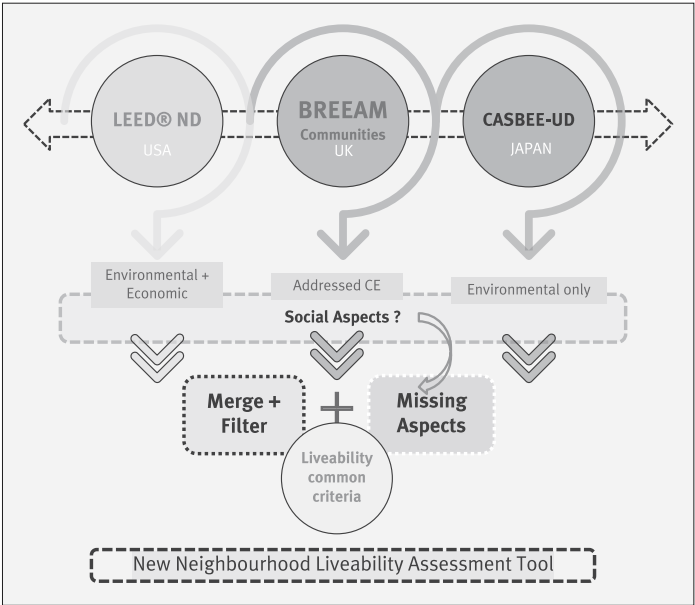


FIG. 3 THE PROPOSED RESEARCH METHODOLOGY

Assessing an urban environment's liveability at the neighbourhood scale is an optimal choice for two main reasons. First, it is small enough as an urban unit to pilot the implementation of innovative design and planning ideas, and large enough to transform systemic and integrated approaches to actual urban development in terms of interactions between the urban context and residents. Second, neighbourhood is considered in terms of an optimal scale for promoting social interactions between residents and assuring local stakeholders' engagement in sustainability initiatives, accentuated in the New Urban Agenda and the SDGs (Sala Benites et al., 2020: 8; Sharifi et al., 2021: 5).

METHODS FOR NEIGHBOURHOODS' PERFORMANCE EVALUATION

The main research concern is whether the newly established urban expansions in the Egyptian urban fringe accommodate the



LEED v4 for Neighborhood Development Plan Project Checklist

Yes ? No

0	0	0	Smart Location & Linkage	28
Y			Prereq Smart Location	Required
Y			Prereq Imperiled Species and Ecological Communities	Required
Y			Prereq Wetland and Water Body Conservation	Required
Y			Prereq Agricultural Land Conservation	Required
Y			Prereq Floodplain Avoidance	Required
			Credit Preferred Locations	10
			Credit Brownfield Remediation	2
			Credit Access to Quality Transit	7
			Credit Bicycle Facilities	2
			Credit Housing and Jobs Proximity	3
			Credit Steep Slope Protection	1
			Credit Site Design for Habitat or Wetland and Water Body Conservation	1
			Credit Restoration of Habitat or Wetlands and Water Bodies	1
			Credit Long-Term Conservation Management of Habitat or Wetlands and Water Bodies	1

0 0 0 Neighborhood Pattern & Design 41

Y			Prereq Walkable Streets	Required
Y			Prereq Compact Development	Required
Y			Prereq Connected and Open Community	Required
			Credit Walkable Streets	9
			Credit Compact Development	6
			Credit Mixed-Use Neighborhoods	4
			Credit Housing Types and Affordability	7
			Credit Reduced Parking Footprint	1
			Credit Connected and Open Community	2
			Credit Transit Facilities	1
			Credit Transportation Demand Management	2
			Credit Access to Civic & Public Space	1
			Credit Access to Recreation Facilities	1
			Credit Visitability and Universal Design	1
			Credit Community Outreach and Involvement	2
			Credit Local Food Production	1
			Credit Tree-Lined and Shaded Streetscapes	2
			Credit Neighborhood Schools	1

Project Name: _____
Date: _____

Yes ? No

0	0	0	Green Infrastructure & Buildings	31
Y			Prereq Certified Green Building	Required
Y			Prereq Minimum Building Energy Performance	Required
Y			Prereq Indoor Water Use Reduction	Required
Y			Prereq Construction Activity Pollution Prevention	Required
			Credit Certified Green Buildings	5
			Credit Optimize Building Energy Performance	2
			Credit Indoor Water Use Reduction	1
			Credit Outdoor Water Use Reduction	2
			Credit Building Reuse	1
			Credit Historic Resource Preservation and Adaptive Reuse	2
			Credit Minimized Site Disturbance	1
			Credit Rainwater Management	4
			Credit Heat Island Reduction	1
			Credit Solar Orientation	1
			Credit Renewable Energy Production	3
			Credit District Heating and Cooling	2
			Credit Infrastructure Energy Efficiency	1
			Credit Wastewater Management	2
			Credit Recycled and Reused Infrastructure	1
			Credit Solid Waste Management	1
			Credit Light Pollution Reduction	1

0 0 0 Innovation & Design Process 6

			Credit Innovation	5
			Credit LEED® Accredited Professional	1

0 0 0 Regional Priority Credits 4

			Credit Regional Priority Credit: Region Defined	1
			Credit Regional Priority Credit: Region Defined	1
			Credit Regional Priority Credit: Region Defined	1
			Credit Regional Priority Credit: Region Defined	1

0 0 0 PROJECT TOTALS (Certification estimates) 110

Certified: 40-49 points, Silver: 50-59 points, Gold: 60-79 points, Platinum: 80+ points

factors that build a socially sustainable neighbourhood and to what extent those neighbourhoods are considered liveable. Assessing an urban community's liveability measures the degree of challenges that could be present in residents' daily life. A high liveability ranking maintains positive health outcomes and behaviours, and is also associated with improved mental health and elevated physical activity (Kasim et al., 2020: 2). Although Egypt has developed The Green Pyramid Rating System (GPRS), an Egyptian environmental rating system for buildings, it evaluates environmental credentials of buildings but has no criteria for neighbourhoods (El-Hafeez et al., 2014: 153).

The research also focuses on how the living standards criteria are incorporated into existing NSATs and whether they are locally adapted, which raises the question of what are the prerequisites for designing locally adapted NSATs for Egypt.

After setting the research base through the Egyptian context and the basic concepts of social sustainability, meaning quality of life and assessment tools, the main research method consists of a comparative analysis of the exist-

ing NSATs in the field of quality of life criteria. Furthermore, by synthesizing all relevant research elements, this paper proposes a methodological process for the Egyptian context: adapting the quality of life criteria and designing NSATs for the planning and regeneration of new Egyptian neighbourhoods.

NEIGHBOURHOOD SUSTAINABILITY ASSESSMENT TOOLS

The Neighbourhood Sustainability Assessment tools (NSATs) are a classification of impact evaluation tools aiming to enhance urban sustainability by stating a list of standards for assessing and declaring the sustainability of residential neighbourhoods (Aguiar Borges et al., 2020: 6). Fig. 3 explains the research attempt to identify the most widely used and verified assessment tools worldwide, also clarifying the common and missing aspects among them. It was found (Sharifi, Murayama, 2013: 75; Szibbo, 2016: 4; Sharifi et al., 2021: 7) that the following three assessment tools were most widely used and referenced concerning the neighbourhoods' performance evaluation:

FIG. 4 LEED®ND CHECKLIST FOR NEIGHBOURHOOD SUSTAINABILITY ASSESSMENT

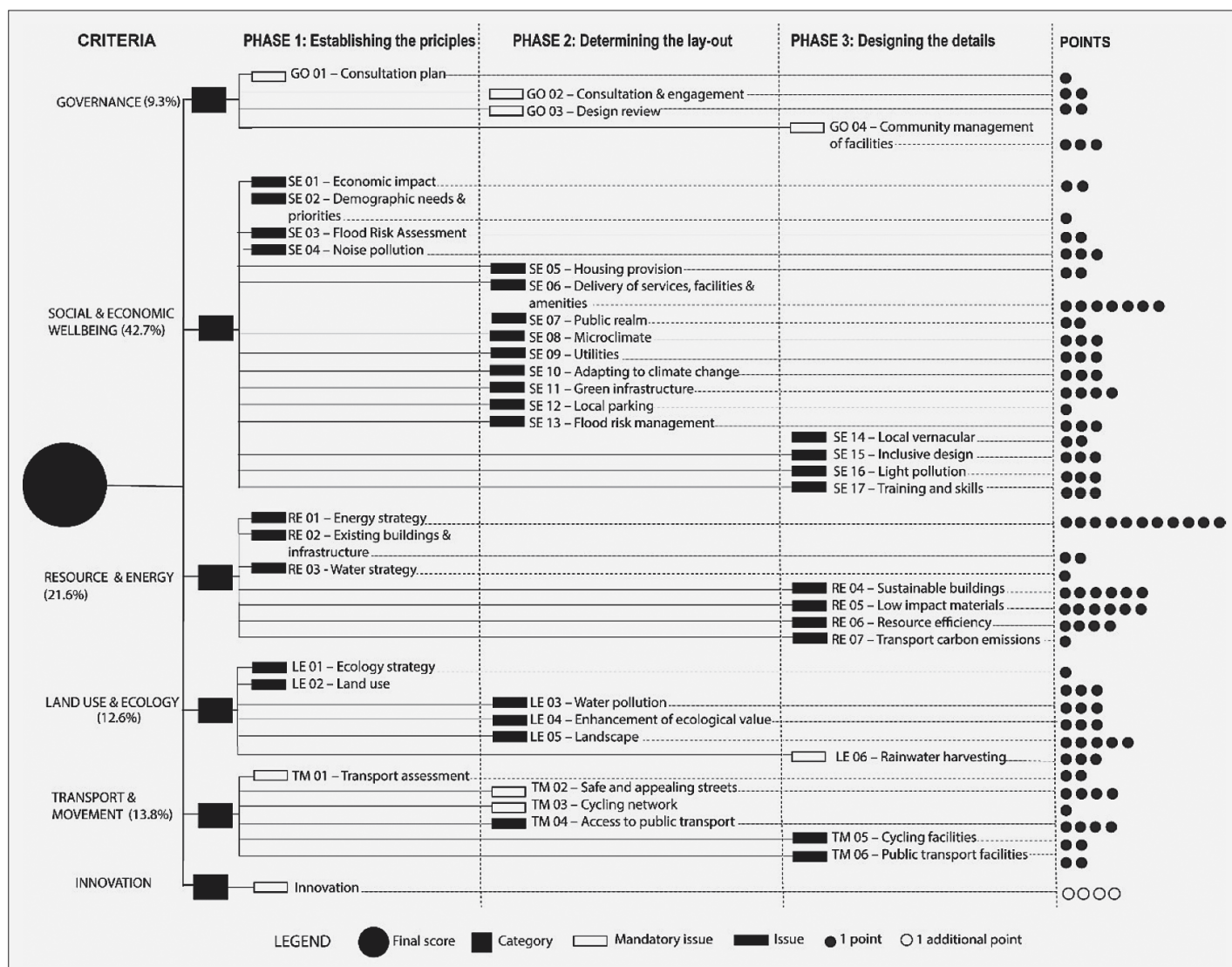


FIG. 5 HIERARCHICAL DIAGRAM FOR THE STRUCTURE OF BREEAM COMMUNITIES

1) LEED®ND – Leadership in Energy and Environmental Design for Neighbourhood Development (LEED®ND) rating system is the most familiar rating system in North America, developed by the US Green Building Council (USGBC) for assessing the sustainability of neighbourhoods (Sizbo, 2016: 4). Designed for neighbourhood-scale projects that are near completion or were completed within the last three years. Therefore, it may help in creating better or alternative solutions within the construction phase. However, its main goals are commercial, as it helps market and fund projects among prospective tenants, financiers, and public officials by affirming the intended sustainability strategies. 33% of its criteria is related to the resources and environment theme.

2) BREEAM Communities – Developed in 2011 by BRE Global, with the aim of consider-

ing the sustainability principles at the early stages of the design process (Sharifi, Murayama, 2014: 245). BREEAM Communities is a certification assessment tool that can be applied to existing and newly established neighbourhoods. It is used to evaluate recent developments, existing and renovated projects in the social, economic, and environmental aspects. Also, it enhances communities' life cycles (Umdu et al., 2021: 209). The system was developed to offer measurement tools determining the outcomes of sustainability using a numerical criterion. This tool works following three main steps. First, establishing the principles; then, determining the layout; and finally, designing the details. It is divided into six major categories (Governance; Social and economic wellbeing; Resources and energy; Land use and ecology; Transport and movement; Innovation; Glob-

al, 2017: 2). The certification is obtained when a score of at least 30% is achieved. One of the main advantages of BREEAM is involving the stakeholders within the design process in order to increase the benefit and developments in accordance with the economic and political change (Revellini, 2022: 950). The main issue with BREEAM Communities is that it is not easy to use as its six major categories has many complicated subcategories which make it difficult to understand and apply easily. Aguiar Borges et al. (2020: 8) tried to illustrate the structure of BREEAM shown in Fig. 5.

3) CASBEE-UD is a product of the collaboration between Japan Green Building Council (JaGBC), and Japan Sustainable Building Consortium (JSBC). It is a member of the CASBEE family, developed to evaluate the environmental efficiency of projects accommodating numerous buildings and open public spaces. This tool mainly focuses on the outdoor environment and the function of building clusters. CASBEE-UD's scope is just limited to specific large-scale projects and is mainly focused on the environmental aspects of sustainability (Sharifi, Murayama, 2013: 79). The environmental quality criteria constitute three major themes "natural environment", "service functions", and "contribution to the local community".

Correspondingly, "environmental impact on microclimates and buildings", "social infrastructure", and "management of the local environment" are used in the evaluation of the environmental load. Scores are given based on the scoring criteria for each assessment item. These criteria applied to assessments are determined by taking into consideration the level of technical and social standards at the time of assessment.

A five-level scoring system is used, and a score of level 3 indicates an "average". However, those sub-criteria represent the Japanese context and are used as the reference level for assessment. Credits are awarded based on the performance above or below the ranking of this subcriteria which makes it more specific to the Japanese environment (Sharifi, Murayama, 2014: 246).

DISCUSSION

The past two decades, a wide range of literature has been published on various topics related to NSATs. This is helpful in reviewing the existing knowledge on them and understanding precisely their aspects of success and failure. However, so far there is no published article that approves the 100% success of any of those NSAT's. This success means

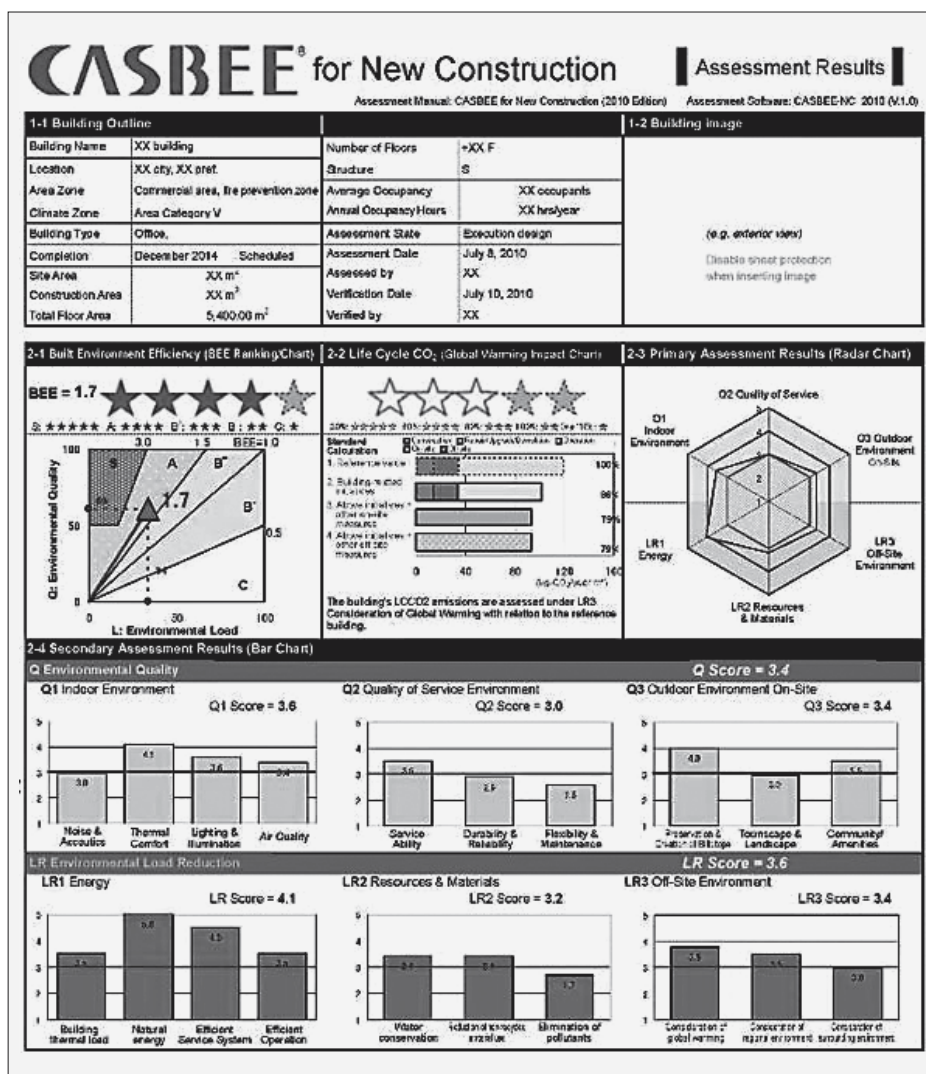
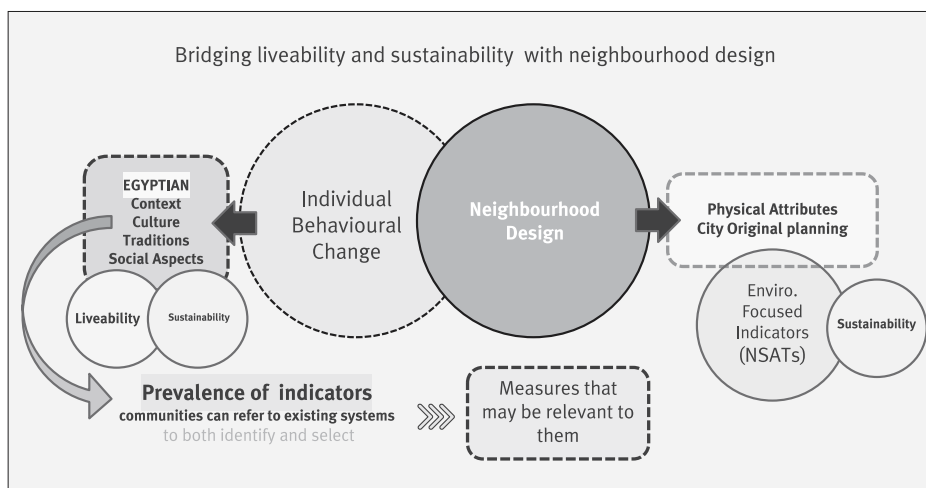


FIG. 6 A SAMPLE FOR THE OUTCOME OF CASBEE-UD ASSESSMENT TOOL

FIG. 7 BRIDGING LIVEABILITY AND SUSTAINABILITY WITH NEIGHBOURHOOD DESIGN



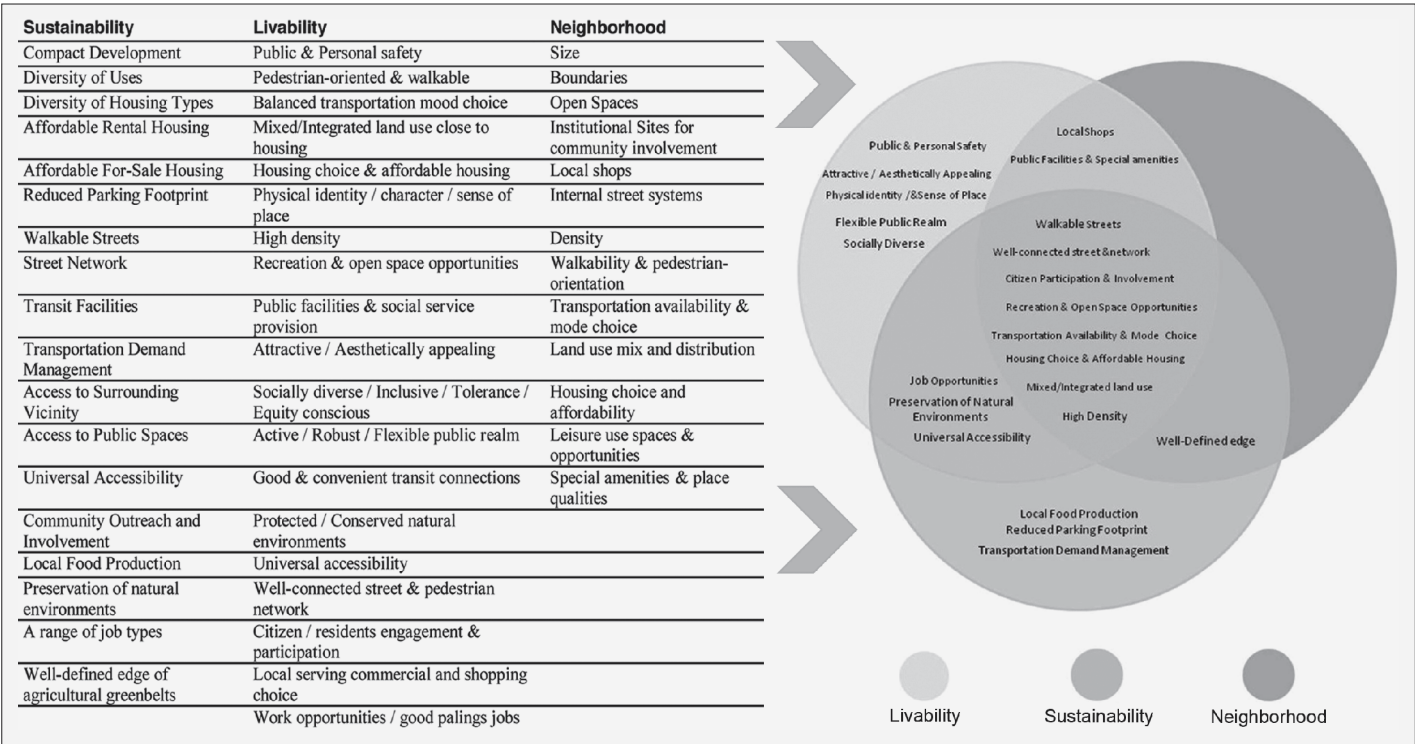


FIG. 8 THE SUSTAINABILITY, LIVEABILITY AND NEIGHBOURHOOD COMMON CRITERIA

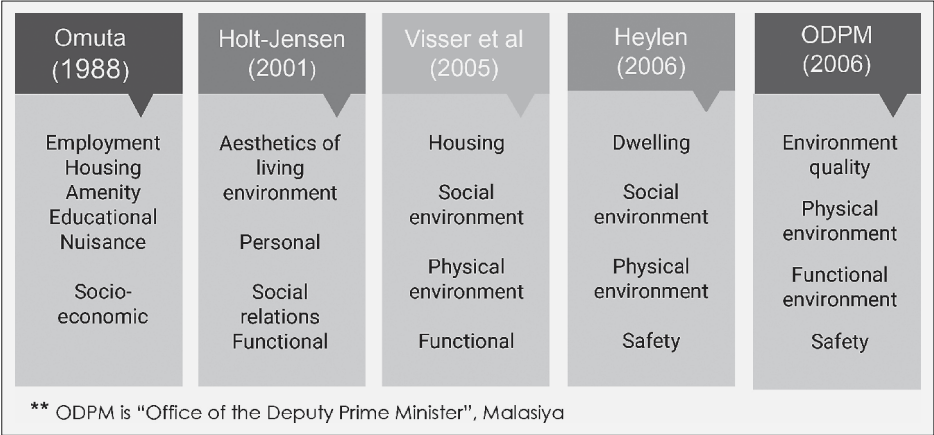
any actions, achievements, and positive outcomes that contribute to informing decision making and guiding transition towards sustainable neighbourhood development. The previously mentioned examples indicate that there is a wide range of assessment tools focusing on the urban, regional, and single building levels. According to (Choguill, 2008: 44) “no single city can contribute to overall sustainability if its own component parts are found not to be sustainable”. However, those tools focus mainly on the environmental and economic sustainability factors, paying less attention to social sustainability, which is a key factor in achieving liveability as shown in Fig. 7.

Although LEED®ND and BREEAM Communities were designed specifically for the neighbourhood scale, they missed some social factors. Those factors were addressed and filtered according to a common liveability criteria developed by (Zarin, Tarantash, 2011: 5) to evaluate to which extent each tool addresses the social factor.

According to the criteria illustrated in Figs. 8 and 9, two liveability factors lists shown in Tables II and III were deducted and used to question the availability of factors or attributes that address the social liveability aspects in an attempt to cover all the possible aspects that affect the achievement of neighbourhoods liveability with a specific focus on the social dimension. Moreover, other aspects in common with sustainability and neighbourhoods’ design in each of the NSAT’s previously explained

Table II explains the missing liveability related aspects in each assessment tool according to the liveability common criteria adapted from Zarin and Tarantash (2011: 6). It is obvious that the three tools do not address the physical identity or sense of place aspects, in addition to the availability of local shops and the population density. Although BREEAM communities and LEED®ND are most widely used, both of them neglected the social diversity parameter. Moreover, LEED®ND missed the preservation of natural environments, while it is the tool most concerned

FIG. 9 LIVEABILITY DIMENSIONS DEFINED IN SEVERAL STUDIES



with environmental matters (Szibbo, 2016: 5). CASBEE-UD and BREEAM communities did not take citizen participation and integrated land use into account, which is a critically important aspect of liveability.

Table III shows another criterion adapted from Leby and Hashim (2010: 74), in which there are some common indicators with the previously illustrated Table II. However, more attention is paid to other three important factors that the three assessment tools failed to address. First, the crime and accidents safety, which is crucial for the inhabitants to feel safe in a neighbourhood, consequently increasing the sense of belonging. The other aspect is the behaviour of the neighbours and their interaction, which shapes the way how a neighbourhood functions and results in better social cohesion. Finally, it was surprising that the three tools do not directly mention the maintenance of the buildings and public realm which will affect the concept of sustainable urban environments provision.

The absence of neighbourhood rating tools in the Egyptian context is a significant gap in the country's urban development and sustainability efforts as there is currently no comprehensive neighbourhood rating tool specifically focused on urban form and sustainability assessment in Egypt. Also, providing a socially sustainable environment is inevitable. Even though the old, historical districts might not fulfil the economic and environmental sustainability criteria, social cohesion and sense of belonging is evident in Egyptian communities. Therefore, investigating the existence of any factors related to this matter in the new urban expansions helps in preserving one of the major factors that provide the essence of the Egyptian communities' liveability.

Table IV illustrates the total number of projects assessed by each tool, the certified ones and the locations of most of them. Also, it was necessary to investigate the number of projects from the Arab countries. It was found that projects from 3 countries were evaluated through LEED®ND and none was certified. As for BREEAM communities, 5 projects were evaluated, 3 of them got certified, one from Oman and 2 from UAE.

The origin of the majority of projects' locations shows that each tool functions much better in the country in which it was developed. According to the list published by the US Green Building Council, the developer of LEED®ND, almost 50% of the evaluated projects are located in the USA, while nearly 20% are from Canada which also lies in North America. The majority of BREEAM communities is in the UK, in addition to a few from

TABLE II THE COMMON CRITERIA FOR A LIVEABLE/SUSTAINABLE NEIGHBOURHOOD USED FOR FILTERING THE NSATS

Liveability Common Criteria		LEED® ND	BREEAM Communities	CASBEE-UD
Liveability	Public / Personal Safety		✓	✓✓
	Attractive / Aesthetically Appealing	✓		
	Physical Identity / Sense of Place			
	Flexible Public Realm	✓	✓	
	Socially Diverse			✓
Liveability + Sustainability	Job Opportunities	✓✓	✓	✓✓
	Preservation of Natural Environments		✓	
	Universal Accessibility		✓	
Liveability + neighbourhood	Local Shops			
	Public Facilities & Special Amenities		✓	✓
Liveability Common Criteria				
Liveability + Sustainability + neighbourhood	Walkable Streets	✓✓		
	Well Connected Streets & Networks	✓✓	✓	
	Citizen Participation & Involvement	✓		
	Recreation & Open Space Opportunities	✓✓	✓	
	Socially Diverse			
	Housing Choice & Affordable Housing	✓	✓	✓
	Mixed / Integrated Landuse	✓		
	High Density			

TABLE III THE LIVEABILITY DIMENSIONS AND INDICATORS USED IN FILTERING THE NSATS

Liveability Dimensions and Indicators		LEED® ND	BREEAM Communities	CASBEE-UD
Social Dimension (social relations)	Behaviour of Neighbours (Nuisance)			
	Community Life and Social Contact	✓		
	Sense of Place			
Physical Dimension (residential environment)	Environment Quality	✓	✓	✓
	Open Spaces	✓	✓	✓
	Maintenance of Built Environment			
Functional Dimension (facilities and services)	Availability and Proximity of Amenities	✓	✓	✓
	Accessibility		✓	
	Employment Opportunities	✓	✓	✓
Safety Dimension (crime and sense of safety)	Number of Crime			
	Number of Accidents			
	Feeling of Safety		✓	✓

Sweden and Spain. Finally, CASBEE-UD which was only used in Japan, shows that the third level of its assessment follows a specific criterion created for the Japanese context which won't be suitable for other contexts globally (Cappai et al., 2018: 7).

TABLE IV THE STATISTICS AND LOCATIONS OF THE EVALUATED AND CERTIFIED PROJECTS BY THE THREE NSAT'S

NSAT'S		LEED® ND	BREEAM Communities	CASBEE-UD
Statistics	Origin	USA	UK	Japan
	Total Number of Evaluated Projects	282	132	8
	Certified Projects	31	67	8
	Projects Location (Majority)	USA	UK, Sweden, Spain	Japan
	Certified Projects Location (Majority)	USA	UK	Japan
	Projects in Arab Countries	3 (2 Qatar, 1 Lebanon)	5 (3 UAE, 2 Oman)	0
	Certified Projects in Arab Countries	0	3 (2 UAE, 1 Oman)	0

It is important to emphasize that the social parameter of liveability can hardly be successfully prescribed on a global level, because liveability represents precisely the beauty of diversity that human communities possess in various parts of the world. Therefore, aspects of liveability, so far neglected, should be included in NSATs as necessarily inclusive but separately defined, depending on the context of the community that is evaluated by them.

The study conducted was based on testing the applicability and performance of selected NSATs in the Egyptian context, the testing strategy used a comparative method approach, which verified the missing aspects using a qualitative comparative analysis. Based on the reviewed literature and the qualitative analysis shown in Tables II and III, the most important missing social sustainability aspects are social interactions and relations between residents, social integration and secu-

rity, and safety. Accordingly, their absence affects the liveability of neighbourhoods.

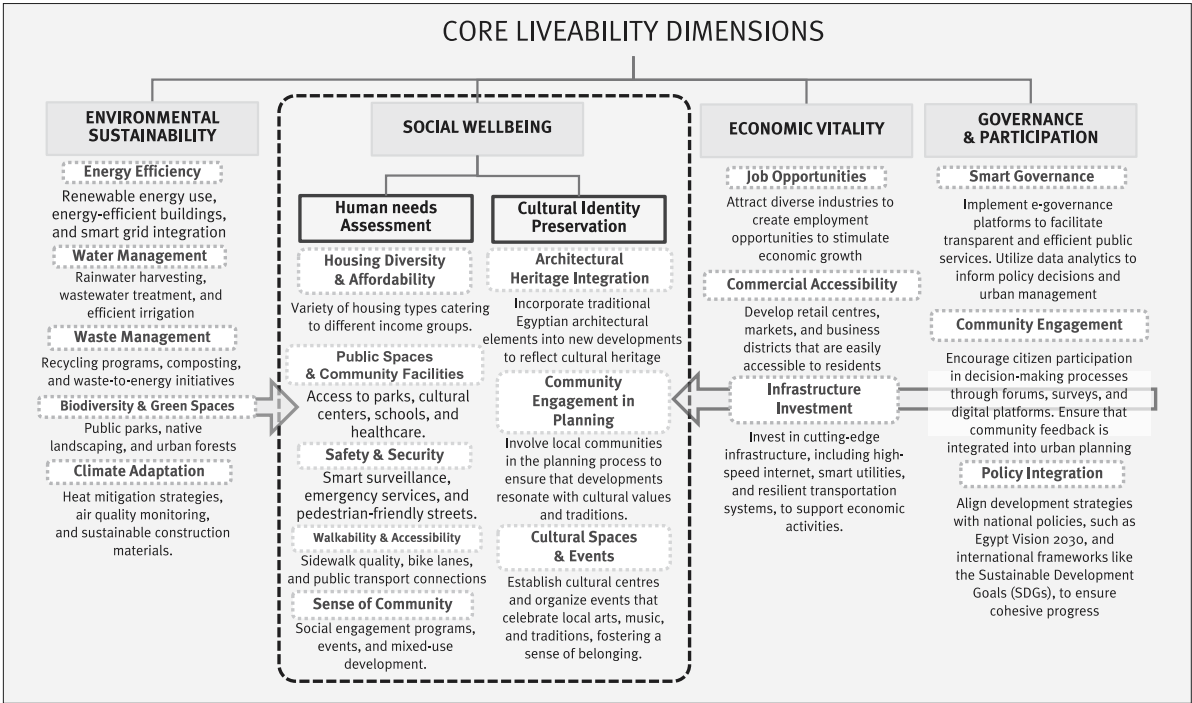
LIVEABILITY ASSESSMENT FRAMEWORK

This research proposes a framework for assessing the liveability of a newly developed neighbourhood within an Egyptian gated community, utilizing sustainability assessment tools adapted to the specific local urban context. The framework evaluates key dimensions encompassing environmental, social, economic, and governance factors. It is structured into three primary components: Fig. 10 illustrates the core liveability dimensions, Figs. 11 and 13 present the adaptation of the Neighbourhood Sustainability Assessment Tool (NSAT), and Fig. 12 outlines the implementation and monitoring strategy. To ensure a comprehensive evaluation, international and regional sustainability rating systems can be adapted to the Egyptian context as follows in Figs. 11 and 13.

A robust strategy is crucial for the successful implementation and continuous monitoring of the liveability framework.

Incorporating human needs and cultural identity preservation into the liveability assessment framework enables the newly developed communities in the Egyptian context to fulfil residents’ material requirements while also supporting their cultural and social well-being. This comprehensive approach aligns with sustainable urban development principles, promoting a dynamic and inclusive community.

FIG. 10 THE CORE LIVEABILITY DIMENSIONS



CONCLUSION

The presented research was initiated by the need to assess the sustainability of communities in Egyptian neighbourhoods located in new urban extensions. For this reason, an analysis of three leading neighbourhood sustainability assessment tools, LEED®ND, BREEAM Communities and CASBEE-UD, was conducted to analyse their applicability to the Egyptian context. These tools could help identify the missing aspects in the existing communities that can make them more sustainable. In addition, they could also provide a better understanding of the critical attributes to be considered in the future development from the early stages of design and urban planning. A detailed analysis of the three assessment tools mentioned, however, revealed their shortcomings as well as their difficult applicability in contexts other than those in which they were created.

In the initial part of this research, liveability in the neighbourhood has been presented as necessary to ensure the development and prosperity of the city as it reflects the real daily experience of the residents. The analysis of assessment tools sought to assess and value the issue of liveability in currently established urban districts by identifying attributes that should be key to designing a healthy and pleasant living environment. What was surprising was the lack of several key aspects of liveability in all three assessment tools. It must be emphasized that some aspects of social sustainability were present in some of the tools, but certainly not systematically or completely. In other words, all the three NSATs failed to meet all aspects of liveability as well as sustainability.

Based on the statistics of the application sites of the tool, it was found that most neighbourhood sustainability assessments

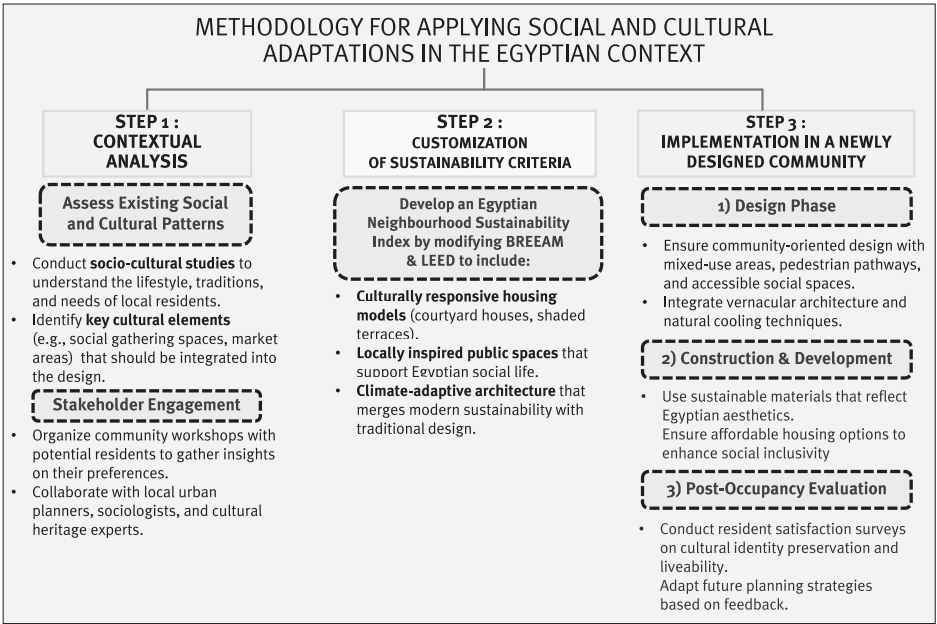


FIG. 11 METHODOLOGY FOR APPLYING NSATs SOCIAL AND CULTURAL ADAPTATIONS IN THE EGYPTIAN CONTEXT

were developed and applied in Western countries and cultures. Essentially, it is questionable whether these tools could be sustainably applied globally to assess residential neighbourhood quality in a diverse physical and cultural environment such as the city of Cairo, Egypt. Therefore, the insights obtained from this research also refer to the need to adapt a certain NSAT to the local context in which it is planned to be applied, in this case, the Egyptian.

The essential part of this adaptation is investigating people’s perceptions about the built environment they inhabit, especially what makes their neighbourhoods liveable in their point of view. Most studies focused only on their satisfaction with their living environment and rarely on the exact important as-

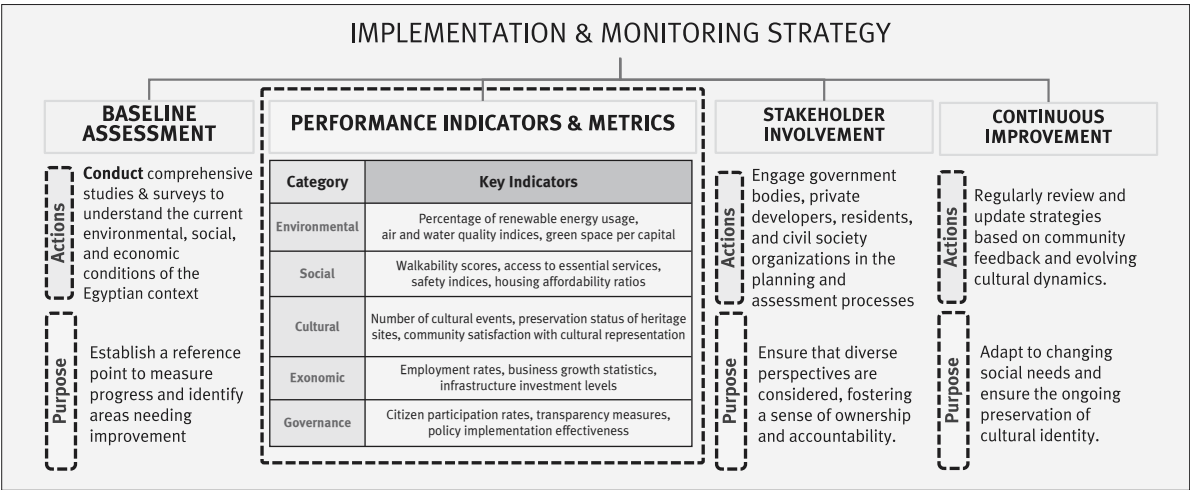


FIG. 12 THE PROPOSED IMPLEMENTATION AND MONITORING STRATEGY

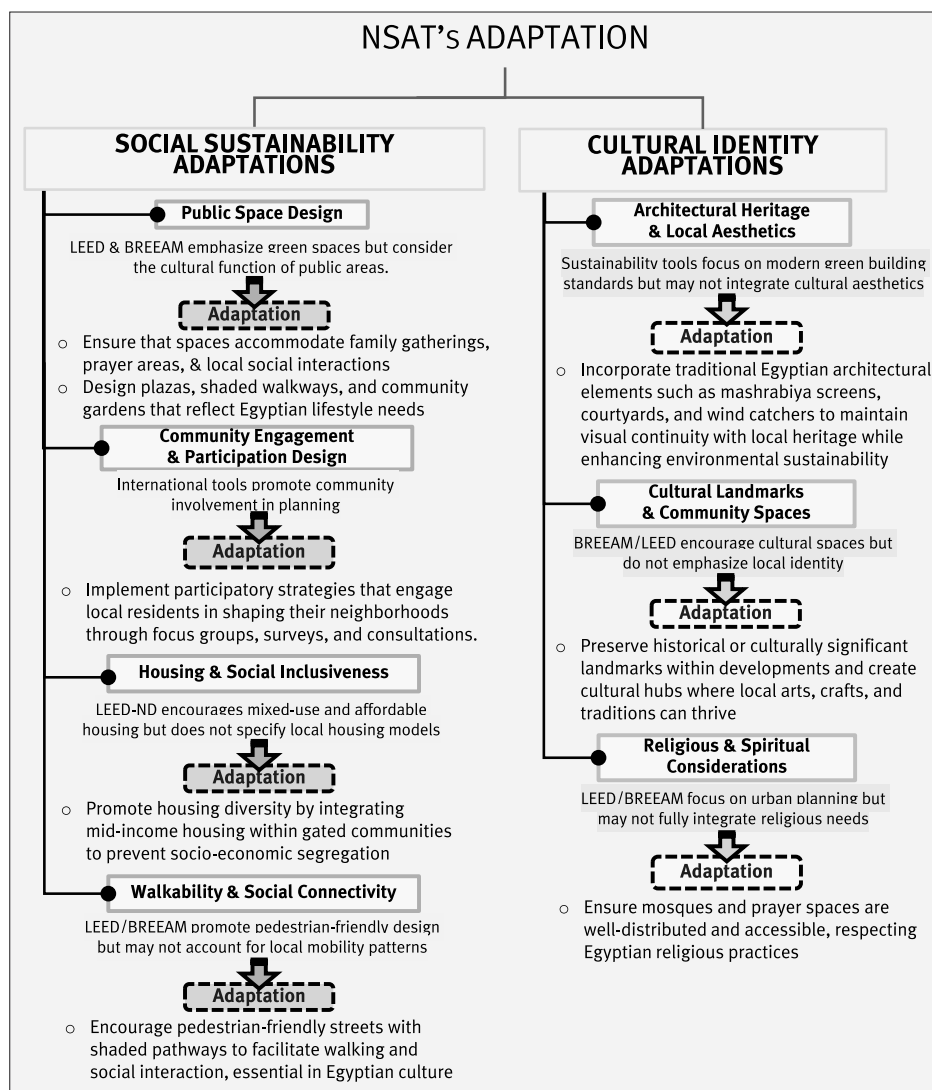


FIG. 13 THE PROPOSED SOCIAL AND CULTURAL ADAPTATIONS TO THE GLOBAL NSATS

pects to them, such as ensuring the overall safety of the community which promotes their satisfaction level, not just satisfied broadly. In conclusion, this research demonstrates the importance of including social aspects in a clear and well-defined way in any neighbourhood assessment. It represents a contribution to understanding the importance of promoting liveability and consequently sustainability, with the potential to create better assessment tools applicable in different contexts. On this track, further research will continue in the direction of formulating a complete and adapted NSAT for Egypt. Finally, it announces research methodology that will include onsite surveys to formulate specific local liveability aspects, as well as case studies of local NSAT applications. Further research should, therefore, continue in the direction of formulating a complete and adapted NSAT for Egypt.

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ILLUSTRATION SOURCES

- FIGS. 1-3, 7, 11-13 Authors
- FIG. 4 <https://www.usgbc.org/>
- FIG. 5 AGUIAR BORGES et al., 2020: 8
- FIG. 6 <https://www.ibecs.or.jp/CASBEE/>
- FIG. 8 Developed by: ZARIN, TARANTASH, 2011: 5-6
- FIG. 9 Adapted from: LEBY, HASHIM, 2010: 74
- FIG. 10 Authors, adapted from: <https://cur.org.au/project/the-healthy-liveable-communities-urban-liveability-checklist/>
- TABLE I Adapted from (Ghonimi, 2022: 7)
- TABLES II-IV Authors

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Methodology: N.N.; conceptualization and methodology phase: N.N., K.C. and R.L.; data collection: N.N.; writing – original draft preparation: N.N.; writing – review and editing: N.N., K.C. and R.L.; visualization: N.N.; supervision: K.C. and R.L. All authors have read and agreed to the published version of the manuscript.



FIG. 1 WORKERS' RESORT ORCE NIKOLOV AT LAKE OHRID, VIEWS FROM THE 1950S:
A) LAKE VIEW; B) ENTRANCE VIEW FROM THE HILL.

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TECHNICAL SCIENCES / ARCHITECTURE AND URBAN PLANNING

2.01.04 – HISTORY AND THEORY OF ARCHITECTURE AND PRESERVATION OF THE BUILT HERITAGE

ARTICLE RECEIVED / REVISED / ACCEPTED: 22. 9. 2025. / 22. 10. 2025. / 16. 12. 2025.



EGON STEINMANN'S ARCHITECTURAL ENGAGEMENT IN NORTH MACEDONIA IN 1946

LAKE OHRID, NORTH MACEDONIA
POST-WAR RENEWAL
PUBLIC BUILDINGS
SKOPJE, NORTH MACEDONIA
SOCIALIST PERIOD
STEINMANN, EGON

The paper offers a comprehensive overview of the dynamic and challenging post-war period that architects faced following World War II. It focuses on the specific circumstances, professional changes, and social reactions that influenced their work and career paths. The aim is to provide a comprehensive biography of architect Egon Steinmann within the context of 20th-century Croatian architecture and to promote Croatian architects working in various regions, particularly in Skopje and Ohrid. It examines two significant projects designed in the first post-war phase in North Macedonia. Steinmann was sent to

Skopje from September to December 1946 to work on the design of large public buildings as part of a solidarity initiative across former Yugoslavia aimed at aiding post-war reconstruction. He designed the Workers' Resort Orce Nikolov, situated along the lakeshore of Ohrid. The Resort currently remains abandoned and neglected, facing an uncertain future. In Skopje, he collaborated with Vlado Antolić on the design of the Ministry of Internal Affairs building, which was later converted into a university building. The building no longer exists; it was destroyed in the 1963 earthquake.

INTRODUCTION

This paper focuses on Egon Steinmann's brief employment at 'Probiro za Makedonija' in Skopje in 1946. This position was part of a Yugoslav-wide exchange and solidarity program aimed at post-war reconstruction. The Macedonian intermezzo represents the architect's intermediate phase, during which he designed significant buildings in Ohrid and Skopje. In Ohrid, Steinmann designed the Workers' Resort Orce Nikolov, and in Skopje, the Ministry of Internal Affairs building.¹ The 1963 earthquake destroyed the building in Skopje, and the tourist resort at Lake Ohrid remains intact despite the passage of time and decades of disuse.

The challenges he faced during the first decade after World War II have not been adequately explored. A full decade has passed since Egon Steinmann's last architectural publication (Muraj, 2015), and only published research serves as a permanent record of findings, ensuring that knowledge is disseminated and shared. This paper aims to complement the architect's biography within the context of 20th-century Croatian architecture and to promote Croatian architects working outside Croatia.

Egon Steinmann² was a former student at the Architectural Department of the High Royal Technical School in Zagreb, where he studied from 1920 to 1924. The frequent political changes and state transitions in the region

reflected the institutional transformations and had a direct impact on Steinmann's professional path (Table I).

He began his career in 1925 as an architectural intern at the Ministry of Construction in the Construction Directorate in Zagreb. In 1930, he joined the Technical Department of the Sava Banovina, which operated until 1939. That year, he was transferred to the Department for Technical Works of the Banovina of Croatia. In 1941, he moved to the Department for Public Works at the Ministry of Transport and Public Works. Before World War II, Steinmann successfully designed public and educational buildings in Zagreb. Notable projects from the 1930s and 1940s include the Institute of Physics on Marulić Square (1927-1929), the Orthopedic Clinic on Šalata, a school in Križanićeva Street (1930), the 'Sokolana' gymnasium in Kacićeva Street (1933), a school in Kušlanova Street (1934), and Post Office II in Branimirova Street (1939).

After World War II, Steinmann contributed to the reconstruction of Macedonia. In September 1946, he was temporarily assigned to 'Probiro za Makedonija', a Design Institute under the Ministry of Construction of the People's Republic of Macedonia located in Sko-

¹ PA.s; PA.t.

² Steinmann, Egon (14/12/1901, Karlovac – 20/2/1966, Zagreb).

³ PA.s.

⁴ Steinmann designed several large industrial facilities, including: The Oil and transport equipment factory in Sestvetski Kraljevac (1948), the incinerator and wagon halls 'Duro Đaković' in Slavonski Brod (1949-1950), the Glass factory in Straza (1954), the Oil factory in Slovenska Bistrica (1960), the Brewery in Otočac (1961), the Oil factory Zagreb (1963), the biscuits and wafers factory 'J. Kras' in Zagreb (1961-1965), etc. (Muraj, 2004).

⁵ Unfortunately, the original architectural drawings have not been found. Only a few photographs and correspondence have been preserved in the family archive (PA).

⁶ Archival research was conducted on two occasions in 2024: in September in the Skopje Department and in November in the Ohrid Department.

⁷ For the Ministry of Internal Affairs building in Skopje, only two drafts for the sewage systems, designed by 'Projektanski biro za Makedonija', are available in the archive, dated 1948 (DARSM-S).

⁸ For the Workers' Resort Orce Nikolov in Ohrid, the archive lacks any architectural documentation. Documentation for the water supply, sewage system, and electrical installations for the adaptation of the Resort Orce Nikolov, dated 1964, is available (DARSM-O).

⁹ The building designed by architects Antolic and Steinmann is presented with a photograph and a floor plan (Tokarev, 2006).

¹⁰ Štejman (Kočevski, 2018).

¹¹ The architect's name is not mentioned.

¹² The motivation for this paper is to supplement architectural data, that Steinmann designed the Workers' Resort at Lake Ohrid in 1946 (PA.s-t).

pje. He worked at a state-owned bureau for a period of two and a half months.³ After returning from Skopje to Zagreb, he began working at the National Design Institute in 1947 and then at the Architectural Design Institute in 1949. From 1951 to 1965, he was employed at the Architectural Design Institute for Industry PLAN, where he specialized in the design and construction of industrial buildings. He held this position until he retired in 1965.⁴

RESEARCH METHODS AND SOURCES

Historical research methods, including document analysis, archival research, and literature reviews, were employed to investigate the past. The research primarily concentrated on gathering data materials from family members’ private archives. Document analysis involved examining and interpreting letters, photographs, legal records, and government reports to extract relevant information.⁵ On-site visits to Skopje and Ohrid were conducted in 2014 and 2024. Archival research entailed examining documents from the State Archives of the Republic of North Macedonia.⁶ The Skopje Department contains minimal records⁷, because the old archive building was destroyed in the 1963 earthquake, and the original documents were lost. The Ohrid Department contains no original materials. The available documentation comes from a later adaptation project.⁸ The limited archival material of original architectural documentation for buildings represented an obstacle. The lack of institutional evidence regarding Steinmann’s work in Macedonia highlights the role of private archives (correspondence material) that compensate for gaps in the national archives.

The literature review explored the Macedonian architecture in English following World War II (Tomovski, Volinjec, and Popovski, 1974; Kulic, 2009; Kulic, Mrduljas, and Thaler, 2012), specifically, the architecture designed by Croatian architects (Tokarev, 2006: 81). Publications are limited in scope to individual projects of the pre-war period (Mickovski and Djokic, 2015), architects (Mahećić, 1999; Mikic, 2002; Ivankovic and Obad Scitaroci, 2011; Bjažić Klarin, 2020), specific styles (Grchev and Grcheva, 2019), broader themes of Skopje architecture (Elezi and Saliu, 2014; Marina, and Pencic, (n.d.)) and former Yugoslav architecture (Kulic, 2009; Kulic and Stierli, 2018).

The literature search focused on gathering relevant information about the buildings designed by Steinmann in Skopje and Ohrid. The Ministry of Internal Affairs building in Skopje is included in an overview of Croatian

TABLE I OVERVIEW OF STEINMANN’S EMPLOYMENT				
Year	Institution/Company	Department	Place	State
1925-1929	Ministry of Construction	Construction Directorate	Zagreb	Kingdom of Serbs, Croats, and Slovenes
1929-1939	Ministry of Construction Royal Ban Administration of the Sava Banovina	Technical Department	Zagreb	Kingdom of Yugoslavia
1939	Ministry of Construction	Department for Technical Works	Zagreb	Banovina of Croatia
1941-1945	Ministry of Transport and Public Works	Department for Public Works	Zagreb	Independent State of Croatia
1946	Ministry of Construction	Design Institute 'Probiro za Makedonija'	Skopje	People's Republic of Macedonia
1947	Ministry of Construction	National Design Institute	Zagreb	People's Republic of Croatia
1949	Ministry of Construction	Architectural Design Institute	Zagreb	People's Republic of Croatia
1951-1965	Architectural Design Institute for Industry PLAN		Zagreb	People's Republic of Croatia

architects’ works in Macedonia by Tokarev.⁹ The building later housed many faculties, so its photograph is included in the celebratory publications of individual faculties (Gjorgoski, 2016: 12). The 1963 Skopje earthquake generated numerous publications and press articles that mention the damage to the University building, but they often state the wrong architect’s name¹⁰ or fail to mention the architect’s name at all (Šcekic, 1963: 15; Petrovski, 2004; Gelevski, 2014: 79). The Workers’ Resort in Ohrid is promoted as a tourist facility (***) (1965), a new resort (Antolic, 1949), and even criticized for its size (***) (1955)¹¹ in professional publications in the 1950s and 1960s. The recent book ‘Revealing the Forgotten Tourism’ (Lekovska, 2023) catalogs the Workers’ Resort as one of the summer tourist-purpose buildings at Lake Ohrid in the 1950s. Possibly, due to a lack of records and the passage of time, the architect’s name is unknown.¹²

CONTEXTUAL FRAMEWORK

The end of World War II in May 1945 led to significant changes in Europe. A new order was established, and the Yugoslav Federation was formed. The post-war rebuilding of this new country was a complex process that occurred in several stages. The primary goal was to restore the war-torn nation and create a new social and political framework. In the first phase (1945-1948), the focus was on the most basic needs (food, accommodation, and key infrastructure). The period was marked by elementary reconstruction, basic infrastructure construction, and an initial industrialization. The widespread destruction created an urgent need for architects and builders to reconstruct and redesign cities,

towns, and buildings in ruins. In the construction sector, housing projects were the first to be developed, followed by schools, kindergartens, and cultural centers (** 1952; V.B., 1953). Efforts were made, wherever possible, to transition to standardized and prefabricated buildings that could be assembled quickly off-site (schools, housing, hospitals, etc.) However, to establish the new social system, the construction of representative buildings also began, drawing on the experiences of interwar modernism.¹³

In essence, the post-war period was a time of significant transition for architects. Many architects adapted their practices under the socialist regime. The shortage of qualified professionals in urban planning and architecture was addressed by promoting collaboration among specialists, organizing them into teams, adhering to established standards, and reducing individual planning efforts. Private offices were nationalized, and the profession was reorganized into state-owned architectural and urban planning offices at various administrative levels, ranging from federal to local city levels. It was the period of centrally organized professional services, in which architects were assigned posts according to bureaucratic command.¹⁴ The state structure at that time gave special significance to state design institutes, which were attached to the federal and six republican ministries of construction and gathered experienced architects (Kulic, 2009: 32-33).

CROATIAN ARCHITECTS IN THE PEOPLE'S REPUBLIC OF MACEDONIA

The industrialization and urbanization of post-war Macedonia required the involvement of external associates, particularly architects.¹⁵ There was uneven development among the six former republics, with Slovenia, Croatia, and Serbia being the developed republics, while Bosnia and Herzegovina, Montenegro, and Macedonia were underdeveloped. For example, Croatia had 320 architects and engineers (Kulic, 2009: 33-34), and Macedonia had only four architects (Tomoški, Čakelja, Artemušin, and Čipan; Čipan, 1974: 22). The formal education in engineering including architecture became possible in Skopje only in 1949 when the Technical Faculty comprising the Departments of Civil Engineering and Architecture was founded and became part of the University of Skopje (now the Saints Cyril and Methodius University in Skopje).¹⁶ Lacking formally educated architects, Macedonian cities were modernized under the leadership of architects from Belgrade and Zagreb (Antolić, 1949a: 19; Cvitković and Kline, 2017: 41). Some worked from

their home republic, while others were sent to Macedonia for short or extended periods. They had various roles, contributing to the renovation and construction of all structures (Mrduljaš and Bjažić Klarin, 2014: 165-166). They worked as urban planners (architects Vladimir Antolić, Antun Ulrich, Branko Vasiljević), as designers (architects Selimir Dumenčić, Ivo Geršić, Slavko Löwy, Dragica Perak, Egon Steinmann, Ivan Vitić), and professors at the Skopje Technical faculty (architects Gjuro Ancel and Valdemar Balley, engineer Juraj Erega) (V.B., 1953; Čipan, 1974: 22).

Central figures in the Macedonian context were prominent architects Anton Ulrich and Vladimir Antolić, who made significant contributions to shaping Macedonia's built environment. Anton Ulrich¹⁷ designed the resort in Oteševo, located on Lake Prespa, in collaboration with Dragica Perak in 1948. It marked the beginning of the development of tourist activities on Macedonia's lakeshores.¹⁸ In 1949, Ulrich relocated to Skopje, where he taught at the newly established Department of Architecture at the Technical Faculty until

¹³ Numerous European countries undertook extensive reconstruction and modernization projects, which, particularly in the context of devastated cities, often led to a shift toward modernist architectural development and urban planning.

¹⁴ The posts in other republics would not have been possible without the organization at the state institutional level. The Federal People's Republic of Yugoslavia (FPRY) was officially established in 1945. The Ministry of Construction, based in Zagreb, was responsible for overseeing all institutions involved in construction work and operated under the Government of the People's Republic of Croatia. The higher level was the Government of the FPRY, along with the Ministry of Construction of the FPRY, located in Belgrade.

¹⁵ Macedonia's interwar architecture featured early modernism, shaped mainly by architects from Belgrade, Zagreb, and Ljubljana. An interwar modernity gradually emerged in Skopje, introducing a synthesis of the heritage remaining in the aftermath of the centuries of Ottoman rule and the modernist architecture of Western Europe (Babić, 2018).

¹⁶ Opportunities to study architecture were not equal. In 1919, the High Technical School was established in Zagreb. In the same year, the Technical Faculty of the University of Ljubljana, was established. The oldest school is the Engineering School at the Lyceum in Belgrade, founded in 1846 (Ladinski, 2023: 99, 101).

¹⁷ Ulrich, Anton (24/12/1902, Zagreb – 27/3/1998, Zagreb), studied in Vienna from 1923-1927 at the Academy of Arts (Kunstgewerbeschule) that later became the High school of applied arts (Hochschule für angewandte Kunst).

¹⁸ It is the first official tourist facility built in Socialist Macedonia and represented an early example of the typical pavilion typology (Mikić, 2002: 204-207; Lekovska, 2023: 18, 113-162).

¹⁹ Antolić, Vlado (4/6/1903, Dežanovac, Daruvar – 13/5/1981, Zagreb), graduated in 1927 from the Technical High School in Vienna (today TU Wien).

²⁰ Steinmann was questioned on 5th and 18th June 1945 (PA.a).

his return to Zagreb in 1953 (Mikić, 2002: 12). Vladimir Antolić¹⁹ was involved in the urban planning practice of Macedonian cities. He created a Regulation Plan for Bitola, Prilep, and Ohrid (Antolić, 1949b-d), as well as the coastal area of Lake Ohrid (Antolić, Apptulah, 1949). He suggested interventions that were sensitive to specific local contexts and situations (Antolić, 1949a: 21-23). The design practices of Antolić and Ulrich were greatly influenced by regional architecture, including its traditional elements and materials.

ARCHITECTURAL CASE STUDY: EGON STEINMANN IN NORTH MACEDONIA

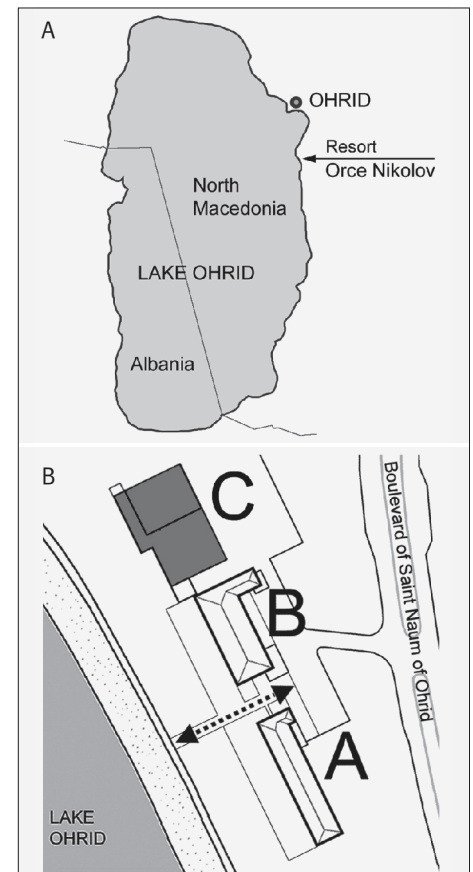
Understanding the life experiences of architects in the post-war period requires detailing all relevant circumstances. This paper examines the challenges individuals were faced with while searching for employment after war. Steinmann was arrested in Zagreb on June 13, 1945²⁰, detained for 14 days in Maksimir, and released without sentence or further investigation on June 30, 1945.²¹ At the end of July, he secured a position as an architectural

engineer in the Department for Technical Works in Kutina.²² However, on the same day, Steinmann, among many others, was dismissed from civil service at the Ministry.²³ He tried to find a job, persistently wrote applications for re-employment, but had no success.²⁴ From May 9, 1945, to April 9, 1946, he was unemployed and went through tough times.²⁵ It was not until April 1946 that he was employed as an engineer in the Technical Department of the Central Office for Workers' Insurance, where he worked as a planner for four months.²⁶ Finally, in August 1946, Steinmann was at the disposal of the Ministry of Macedonia, by the decision of the National Ministry of Labor.²⁷ He was temporarily assigned to work at the Ministry of Construction in Skopje. Immediately in September 1946, Steinmann accepted the job and traveled to Skopje.²⁸ He was employed at 'Probiro za Makedonija', focusing on design challenges related to large public buildings. He designed the Workers' Resort at Lake Ohrid (later the Orce Nikolov hotel) and the Ministry of Internal Affairs building in Skopje (later the University building, home to the Faculty of Philosophy), where he collaborated with Vlado Antolić (Fig. 2).



FIG. 2 LOCATIONS OF SKOPJE AND OHRID ON THE MAP OF NORTH MACEDONIA. SKOPJE IS THE CAPITAL AND LARGEST CITY OF NORTH MACEDONIA, LOCATED IN THE NORTHERN PART OF THE COUNTRY. LAKE OHRID FORMS PART OF THE BORDER BETWEEN SOUTHWESTERN NORTH MACEDONIA AND EASTERN ALBANIA.

FIG. 3 A) THE MAP OF LAKE OHRID WITH THE LOCATION OF THE HOTEL ORCE NIKOLOV; B) THE CURRENT SCHEMATIC LAYOUT OF BUILDINGS: HOTEL ORCE NIKOLOV WITH ACCOMMODATION BUILDING (A) AND RESTAURANT (B), AND SLAVIA BEACH RESORT (C).



21 PA.b.

22 At the beginning of July, he contacted the Ministry of Construction in search of a job.

23 From civil service were dismissed: Vlado Švob, Ivo Bartolić, Juraj Bertol, Mijo Bertak, Zvonimir Crnokrak, Mirko Kovac, Kornel Klemencić, Pero Mastnak-Car, Egon Steinmann, Olga Lovincić, Josip Prebeg, Josip Knežević, Hinko Vichra, Zicrija Ovcina, Dujo Budak, Milivoj Sazunić, Branko Vasilic (PA.c).

24 PA.d.

25 At the end of World War II, Steinmann faced a personal tragedy when his family's house at 35 Jakiceva Street was demolished in an air raid on Zagreb on February 22, 1944 (Muraj, 2004: 171).

26 PA.e.

27 PA.f.

28 Steinmann was entitled to reimbursement for expenses related to his relocation (travel and moving expenses). After completing the work, he should return to the Ministry of Construction in Zagreb (PA.g).

29 Regarding the summer tourism, summer holidays were taking place alongside the shores of Macedonia's three natural lakes – Ohrid, Prespa, and Dojran Lake. Lake Ohrid, one of the oldest and deepest natural lakes in Europe, has a rich natural and cultural heritage. The lake is located at a height of 695 meters above sea level. It is 30 kilometers long, about 14 kilometers wide, and has a maximum depth of 285 meters. Ohrid and Lake Ohrid were accepted as Cultural and Natural World Heritage Cities by UNESCO in 1979 and 1980 (Lekovska, 2023: 111, Petrevska and Collins-Kreiner, 2018).

30 Limited tourist activity existed before the mid-20th century.

31 This is one of the busiest beaches, always tidy and clean.

32 Orce Nikolov refers to a prominent national hero and communist activist. The name is given to several institutions (academic institutions – high school, kindergarten, etc.) and streets.

THE WORKERS' RESORT AT LAKE OHRID

In the post-war period, Ohrid developed as an important summer tourist center. Both the city and the lake hold great natural and cultural value for the entire region.²⁹ Tourism in Macedonia was developed mostly for local citizens and workers. Domestic tourism development was characterized by a system of social tourism, represented by tourist facilities that included an extensive network of resorts (for workers, children, and youth), as well as camping sites, among others. The funding related to domestic tourism was minimal, resulting in modest building construction. The facilities were reserved for the members of a particular trade union, state administrative unit, youth organization, or a socialized company (the Yugoslav National Army, the Red Cross, etc). In this period, tourist construction activity happened along the shore of Lake Ohrid.³⁰ Modern accommodation facilities (hotels, resorts, etc.) were built around Lake Ohrid.

The Workers' Resort is located in the St. Stefan settlement, a beachside place along Lake Ohrid, located around 5 kilometers south of the city of Ohrid (Fig. 3a).³¹ It was named 'Orce Nikolov'.³²

The tourist complex was constructed in 1949 within the planned area designated for workers' resorts.³³ At that time, along the lake-

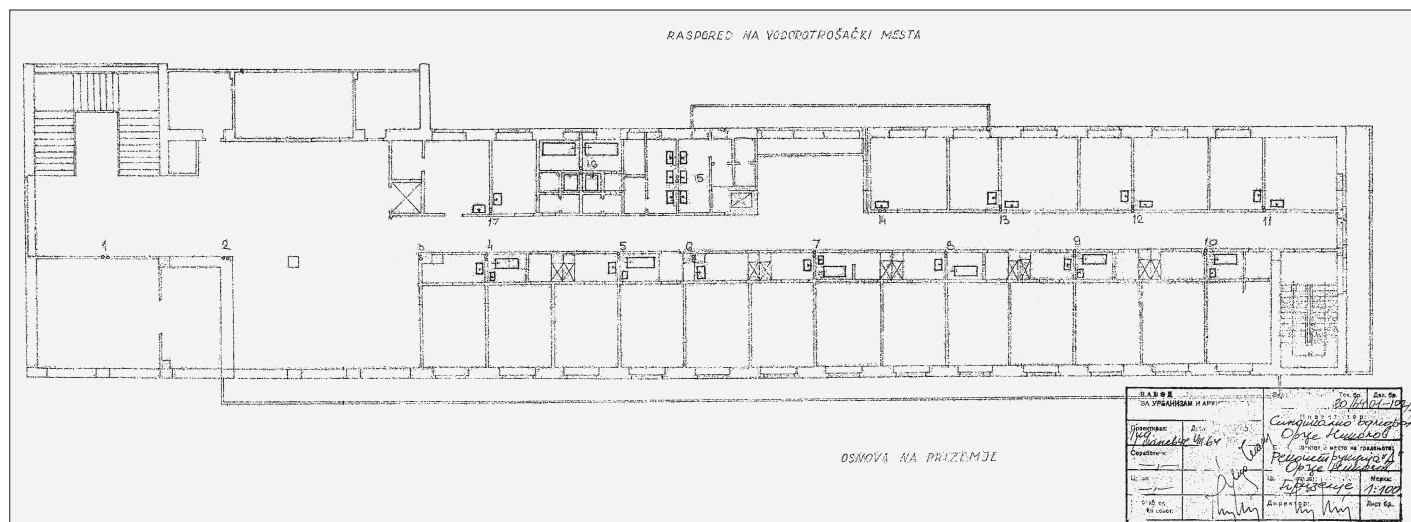


FIG. 4 WORKERS' RESORT ORCE NIKOLOV, ACCOMMODATION BUILDING (A), DRAFTS FOR THE WATER SUPPLY, GROUND FLOOR PLAN, RECONSTRUCTION, 1964

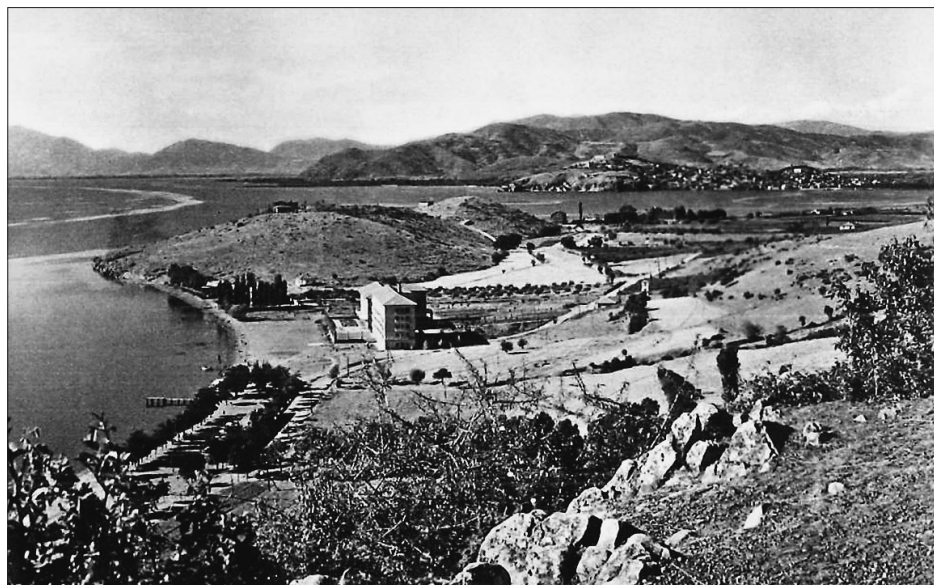
shore, there was limited tourist architecture activity (Fig. 5).

Afforestation was planned for the bare landscape. The resort is situated in an ideal location.³⁴ The resort complex consists of two buildings along the very shore of the lake, each serving a different purpose: the southern, higher and narrower one for accommodation units (A) and the northern and wider L-shaped one for community areas (B) containing restaurant and outer terrace (Fig. 3b). The access road, parking space, and raised covered entrance are from the top (east). The buildings are not connected. A pedestrian walkway between the buildings leads down to the lake-shore promenade and beach. The main entrance features a reception area, hall, lobby, and a main three-flight staircase, while the ac-

commodation units are located on the ground floor and the four floors above (Fig. 4).³⁵

The linear block features a simple architectural layout, with rooms arranged along a central corridor and staircases at both ends. Rooms facing west, which include bathrooms, offer a view of the lake. Some of these rooms also have balconies on the 1st, 2nd, and 3rd floors, as well as on the south gable side. In contrast, the smaller rooms facing east only include a sink. The façades of the building are uniform, featuring a regular rhythm of openings. Still, they also include a variety of opening sizes (windows, French doors, balcony doors), and eaves, along with balconies and loggias. From the lake perspective, large-scale structures with pitched roofs increasingly dominate the landscape (Fig. 1).³⁶ The

FIG. 5 WORKER'S RESORT ALONG THE LAKEFRONT OF OHRID AND THE SURROUNDING NATURAL AND UNBUILT CONTEXT. IN THE BACKGROUND IS THE CITY OF OHRID.



33 The Regulation Plan of Lake Ohrid defines the lakeshore with several areas and centers. Ohrid, as the main tourist center, has representative hotels along the bay, and zones of temporary and permanent beach hotels for many people along the beach. From Ohrid towards the south, there is a family and mixed tourism area, a zone of smaller tourist centers, and individual smaller health resorts. The St. Stefan zone is planned as a tourist zone for a recovery facility for many people (specifically, for workers' resorts). Further south, health resorts for many people (sanatoriums) are planned (Antolic, 1949: 40, 44).

34 The resort is situated in a stunning natural landscape (lake coast, long beach, and near mountains), providing a setting for relaxation and recreation. It is close to the main road.

35 Drafts for the water supply, sewage system, and electrical installations for the adaptation (expansion and reconstruction) of the Resort Orce Nikolov (Buildings A and B), dated August 1964 (DARSM-O).

36 In the future, the scale of buildings should be adapted to the environment (Antolic, 1949: 40, 44).

37 Comparing the resort in St. Stefan to the one in Oteševo reveals the following: Both resorts are designed for workers and situated in a natural landscape along the lakes. They were designed by Croatian archi-



FIG. 6 WORKERS' RESORT ORCE NIKOLOV AT LAKE OHRID, RECENT VIEWS: A) LAKE VIEW IN 2014; B) ENTRANCE VIEW IN 2024

strong geometries characteristic of the modernist style, evident in the design and construction of early tourist structures, are juxtaposed with the organic forms of the surrounding natural landscape.³⁷

With the increase in tourist activity along the Ohrid lakeshore, many of the modest structures started to be replaced with hotels and hotel complexes to attract international visitors as well.³⁸

Today, the hotel has two objects, Slavija and Orce Nikolov. The Slavija hotel was reconstructed in 2013 and is open to guests.³⁹ The hotel Orce Nikolov has been closed for more than a decade (Fig. 6). Over time, this state of physical decay makes the building irreparable and contributes to the overall decline of its surrounding neighborhood. The present-day abandoned building, along with further physical deterioration due to weathering and a lack of maintenance, negatively impacts its future.

THE MINISTRY OF INTERNAL AFFAIRS IN SKOPJE

The building was situated on the southern bank of the River Vardar in the city center

fects and built during the same period. However, the size of the locations, facilities, and typologies is not comparable. The architectural composition in Otesevo consists of simple linear pavilions independently placed on the sloping terrain, creating a rhythmical composition with the surrounding context.

³⁸ The construction activity along the Ohrid's lakeshore in St. Stefan continued in 1956, where the architect Pantelej Mitkov designed Hotel Crvena Zastava (today Hotel Aqualina; Lekovska, 2023: 124).

³⁹ The Sahara Group, an Indian company, purchased and reconstructed the building in 2013. Hotel Slavija Beach Resort is a high B-category hotel.

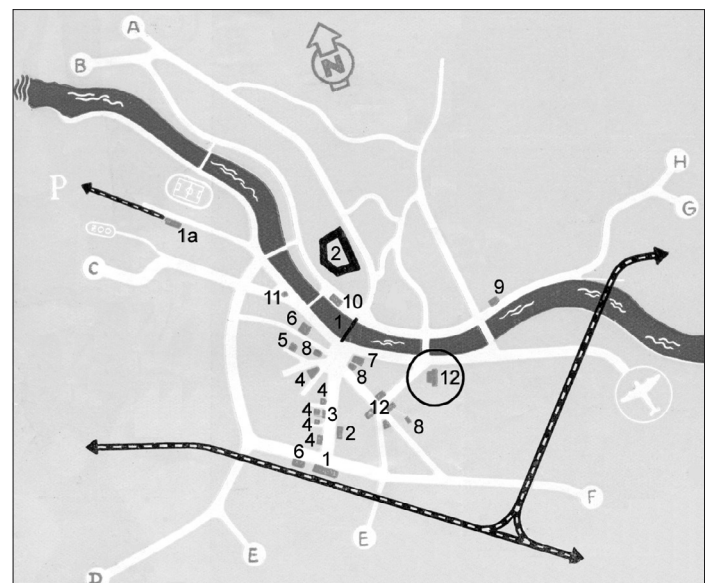
⁴⁰ The building was marked as an administrative building on the tourist map of the city.

(Fig. 7) and was oriented towards the main street (today Stiv Naumov Street), leading to the bridge (today Phillip II of Macedon Bridge) and across the river to the other bank (Fig. 9).

The large, symmetrical courtyard building, with two additional elongated wings, was a city landmark.⁴⁰ The core element of the building was an open courtyard around which the surrounding structures were grouped. The central, highest structure, with its long main porch, provided a welcoming, covered transition from the outdoors and flanked the main façade. The building had two secondary outer staircases and covered side entrances offering multiple points of access. The building had a basement, 4 (5) floors, and a pitched roof. A unified, rhythmic façade em-

FIG. 7 TOURIST MAP OF SKOPJE WITH THE LOCATION OF THE BUILDING (MARKED WITH A BLACK CIRCLE). LEGEND: A. ROAD TO KAČANIK, B. ROAD TO SARAJ-MATKA, C. ROAD TO NEREZI, D. ROAD TO VODNO (NEREŽI), E. ROAD TO VODNO, F. ROAD TO DRAČEVO, G. ROAD TO TITO'S VELES-GEVGELIJA, H. ROAD TO KUMANOVO;

1. RAILWAY STATION,
- 1A. LILLIPUT RAILWAY (SARAJ-MATKA),
2. FORTRESS,
3. STONE BRIDGE,
4. HOTEL,
5. HOTEL ARAB HOUSE,
6. POST OFFICE,
7. NATIONAL BANK,
8. MUSEUM,
9. NATIONAL LIBRARY,
10. NATIONAL THEATRE,
11. MONUMENT TO THE LIBERATORS OF SKOPJE,
12. ADMINISTRATIVE BUILDING.



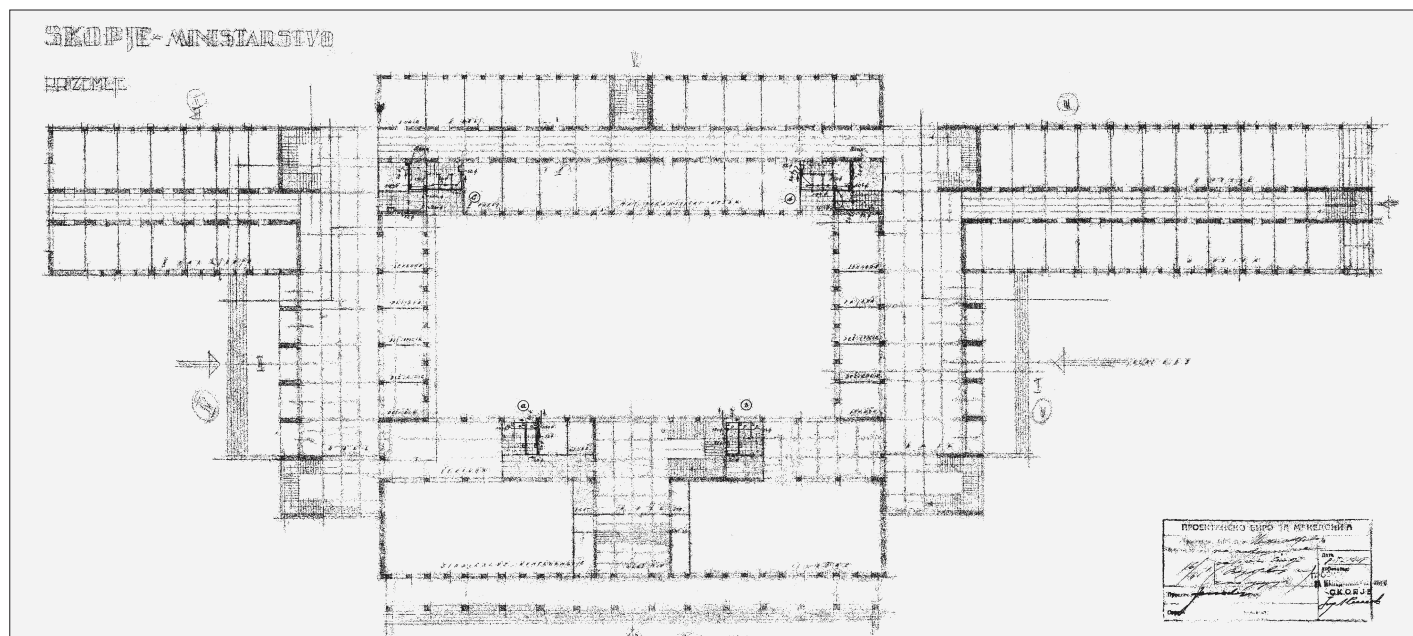


FIG. 8 SKOPJE – MINISTRY, DRAFT FOR THE SEWAGE SYSTEM, GROUND FLOOR PLAN, 1948

played a form of mass-based design, where different sections of the building were given distinct heights and rooflines. The repeating windows and cornice served to unify the overall composition and create a sense of order. It was a common architectural layout where six wings housed offices connected by a central corridor for access and facilitated movement between floors via shared seven stairwells (Fig. 8).⁴¹

ARCHITECT'S OBSERVATIONS ABOUT WORK

Steinmann was satisfied working in Skopje and had a positive experience with the design assignments:⁴²

I've never been so satisfied with perfectly completed architectural work, and I probably never will be again.

In addition to a profound appreciation for architectural work, he also mentioned the speed of work, which impacted deadlines and project completion.

I quickly finished some large plans, and we already carried copies in our briefcases.

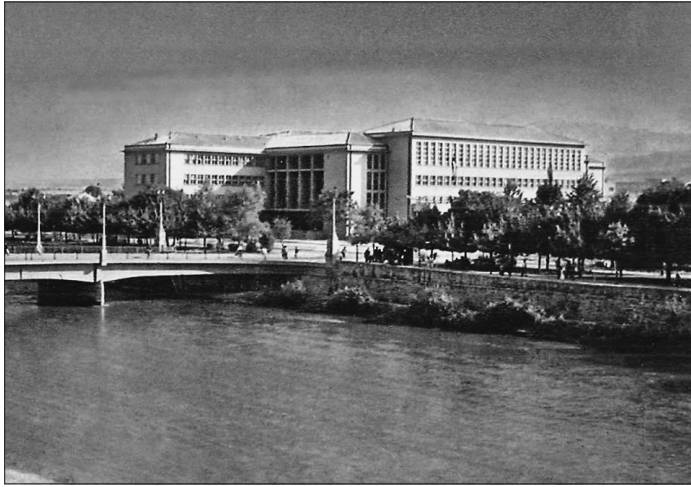
Politicians as investors were interested in the project's progress. Two situations can be selected regarding the pressure to finish the job quickly. The first incident involved the Macedonian Prime Minister Koliševski visiting the office to review the plans for the workers' resort. The second incident occurred outside the office, in a café, in the presence of the Minister, when the security intelligence service requested that the Ministry's design must be prioritized.⁴³ Steinmann described

the office environment as both cheerful and international, suggesting a positive and inclusive atmosphere with a diverse workforce. There were colleagues from various cultural backgrounds and architects from around the world – including those from Slovenia, Serbia, Macedonia, Croatia, and Germany. Steinmann was in contact with architect Vladimir Antolic, who was based in Ohrid at that time.

Steinmann also traveled across the country, visiting regional towns and natural beauties. In September, he reported from Bitola – a visit to Prilep, the Stobi archaeological site, and Lake Prespa.⁴⁴ In his words:

*We're leaving on a tour early tomorrow morning. We won't be far from Thessaloniki and the sea! We're moving along the roads of Hellenic travelers.*⁴⁵

After two months in Skopje, Steinmann felt a desire to depart. He hoped to continue the business cooperation after returning to Zagreb in December 1946.⁴⁶ He received written confirmation acknowledging his good work in Macedonia.⁴⁷ Communication during project development continued and was complemented by letters.⁴⁸ The writing from March 1948 reported that the building was being constructed according to the submitted plans. The detailed drawings for timber windows and doors had been completed. It was up to Steinmann to develop details for the façades, minister's office interior, vestibules, staircases, and halls.⁴⁹ In October 1949, due to the urgency of completing the Ministry 'palace', Captain Majekovski arrived in Zagreb to discuss all necessary technical details.⁵⁰ The building was initially designed for



41 Two drafts for the sewage system (ground floor and IV-V floor plan) are available in the archive, dated 1948 (DARSM-S).

42 Based on the private letters to his family (PA.o).

43 PA.n.

44 PA.m.

45 The phrase encapsulates a sense of exploration and historical connection with the legacy of Hellenic civilization (PA.l).

46 He hoped that no one would interfere with his plans (PA.n).

47 The confirmation is from the 'Probiro' manager (PA.i).

48 To finish the work he had started, regular updates were important. The attachment of the letter of December 19, 1946, contained a conceptual project and sketches that were sent for opinion and corrections; however, unfortunately, the drafts are not preserved (PA.h).

49 Twenty drafts were sent to Steinmann's private address from the 'Probiro', signed by the director Simov. He reported two significant changes. First, related to the timber roof structure covered with asbestos plates. Due to the large spans and the need to achieve the required height, the detail of the cornices was modified. Secondly, in block no. 1 (main entrance) on the 3rd floor, the mezzanine structure was inserted, and the 4th floor was created towards the courtyard (PA.j).

50 It was up to Steinmann to finish the necessary plans for completing the building, especially the façade (PA.k).

51 Geologists consider the Skopje valley the most active seismic region in former Yugoslavia. Throughout history, until the year 1962, 58 strong earthquakes were recorded, among them the earthquake in 518, which destroyed the historical city of Skupi, and the one in 1553, which completely wrecked Skopje. On the MCS scale, the earthquake's intensity was estimated to range from 8 to 9 (Steinmann, 1964: 1).

52 With over 3,000 injured and 150,000 left homeless (B., 1963; Ščekić, 1963; Gelevski, 2014).

53 Steinmann wrote a postcard to his family (PA.p).

54 Steinmann, Viktor (21/9/1917, Zagreb – 7/2/1995, Zagreb), graduated in 1942 from the Civil Engineering Department of the Technical Faculty in Zagreb. After the Skopje earthquake, he focused his work on masonry buildings in earthquake-prone areas.

55 PA.r.

the Ministry of Internal Affairs but was later repurposed as a university building. The building contained the Rectorate and the Faculties of Law, Economics, and Philosophy (Gjorgoski, 2016: 12), and operated for 14 years until the 1963 earthquake.

1963 SKOPJE EARTHQUAKE

Skopje has a history of devastating seismic activity. On July 26th, 1963, a strong earthquake struck Skopje.⁵¹ Roughly 75% of the city was destroyed, and 1,070 people were killed.⁵² Steinmann was deeply affected by the destruction in Skopje. He wrote:

*For the second day now, every night I have been watching on TV the demolition and rescue details. My Hotel Macedonia and my Faculty of Philosophy are gone. Those buildings were built with brick frames. Only the concrete skeleton construction remained.*⁵³

More than 67.4% of the dwelling houses, or 75.1% of the dwelling area, were unusable immediately after the earthquake. Public buildings, schools, and hospitals also suffered heavy damage. All University buildings were damaged; some of them so heavily that they had to be demolished later (Petrovski, 2004: 4). Viktor Steinmann⁵⁴ visited Skopje on business in August 1963 and sent a message to his older brother confirming that one part of the building's wing had collapsed.⁵⁵ The earthquake caused significant damage to the University building (Fig. 10), necessitating extensive reconstruction efforts and, consequently, the construction of new buildings at a new location.

DISCUSSION

The two Steinmann buildings offer broader significance in the post-war Macedonian context and reveal the priorities of post-war ar-

FIG. 9 POSTCARD WITH THE BUILDING ACROSS THE VARDAR RIVER

FIG. 10 COLLAPSED WING OF THE UNIVERSITY BUILDING AFTER THE EARTHQUAKE IN 1963

chitecture reconstruction. In general, they confirm the influence of the new state. The state, as an employer, established design institutes and formed international teams with recognized and trained professionals, selecting external experts as leaders. Thus, they enabled collaboration between external and local expertise on the site. The state, as an investor, except for priority buildings, also built representative ministry buildings. The Ministry building in the capital city featured monumental architecture to project stability and authority (institutional symbolism). A variety of programmatic choices is evident in the decision to invest in a resort for workers at the lakeshore of Ohrid (social component), but anticipated modest building construction. The state determined budgeting and programming, with higher amounts and larger areas for the ministry building, and minimal funding and square meters for the mass

resort structure. The state prioritized efficiency and speed with a planned construction deadline, and easily assembled buildings in terms of design and construction.

On a personal level, the two buildings exemplify Steinmann's role, as he was among the first foreign architects to participate in post-war reconstruction in 1946. The concepts of buildings were designed in a very short period. Later project developments and potential collaboration (as opposed to individual work) are not feasible to address. He certainly experienced deep satisfaction and a sense of purpose from the work itself, beyond just getting the job done (professional fulfillment). In reference to his biography within the context of 20th-century Croatian architecture, these are important buildings. They represent a continuation of his earlier pre-war work (with the same employer), a continuation of his design practice focused on public buildings (involving the same tasks), and a continuation of purely designed examples of modernist architecture (demonstrating the same architectural expression).

CONCLUSION

Finally, a detailed examination of the architectural interactions between Croatia and Macedonia during the post-war period represents a valuable area for future research. Identifying the relevant institutions in both countries is essential, particularly the Croatian institutions from which architects originated as well as the design institutes in Macedonia where they were employed. The comparison could provide useful insights into institutionally organized exchanges.

For similar research, it would be useful to focus on securing all required documentation. The research process limitation arose from a language barrier. In future work, researchers should consider relevant Macedonian scholarly resources that are not available in English.

The number of architectural projects designed by Egon Steinmann in Macedonia remains an open question, with no definitive answer readily available. In letters to his family, in October 1946, Steinmann mentioned the design for a gymnasium in Štip and a hotel in Bitola.⁵⁶ Of the two built buildings, one no longer exists; it was destroyed in the Skopje 1963 earthquake, while the future of the other at Lake Ohrid remains uncertain. The limited architectural documentation has given the author an additional challenge; to convey a coherent narrative about Steinmann's post-war architectural projects in North Macedonia.

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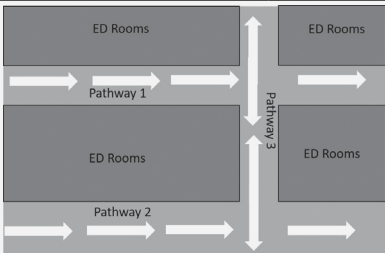
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ILLUSTRATION SOURCES

- FIG. 1 Unknown author of the photographs. Private archive.
- FIGS. 2, 3 Drawn by the author, according to Google Maps
- FIG. 4 DARSM-O
- FIG. 5 Postcard. Private archive.
- FIG. 6 Author
- FIG. 7 Reproduced by the author based on a tourist map from the 1960s
- FIG. 8 DARSM-S
- FIG. 9 Private archive
- FIG. 10 DARSM-S, via Picryl.com

TABLE I CONCRETE MODEL FOR WAYFINDING TRANSITIONAL SPACES FOR EMERGENCY DEPARTMENTS

Identification of the Entrance and Exit		
		
Entrance – Features: (A) A recess (B) A canopy (C) A red sign carrying the name (D) An asymmetrical façade in shape	Exit – Features: (A) A recess (B) A canopy (C) A green sign indicates the Exit (D) An asymmetrical façade in material	
Well definition by interior features for the pathway		
	Pathway – Features: (A) Two parallel, continuous, long walls (B) Repetitive (light, handrail) (C) Contrast in the tone of the floor	
Create a visual character landmark and differentiation of space for a distinct identity through interior design		
 Pathway 1 Landmark: Sided o'clock Interior design: Medium grey colour scheme	 Pathway 2 Landmark: Furniture setting Interior design: Light grey colour scheme	 Pathway 3 Landmark: Wall Art Interior design: Dark grey colour scheme
Easy navigation within circulation routes		
		
Layout Design – Features: (A) Straight movement pattern, (B) Linear spatial design		

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AN EXPLORATION OF PHYSICAL PROPERTIES FOR WAYFINDING WITHIN TRANSITIONAL SPACES EMERGENCY DEPARTMENTS IN THE UNITED ARAB EMIRATES

EMERGENCY DEPARTMENT
HOSPITAL
PHYSICAL PROPERTIES
TRANSITIONAL SPACE
WAYFINDING

Wayfinding has only recently gained significance in the architecture of medical facilities. While several studies have examined hospital architecture, few have focused on wayfinding within emergency departments in the UAE. This study investigates the influence of transitional spaces and their physical properties on wayfinding. The Wayfinding Transitional Spaces Matrix (WTS-M), derived from the 2023 International Health Facility Guidelines, was utilized in a mixed-method approach. The regulations provide criteria from an architectural standpoint. This research examined five physical properties:

entrances and exits, pathways, landmarks, circulation routes, and interior design. The paper assessed three emergency departments in hospitals across the UAE, employing binary coding ($\sqrt{=1}$, $\times=0$) to evaluate each aspect. The data was converted into percentages for comparative analysis. Landmarks were absent in any of the cases; in contrast, circulation routes were seen at a rate of 100%. The presence of other features differed. The conclusion provides a preliminary measure to define localized criteria that can improve the overall wayfinding experience in medical buildings in the UAE.

INTRODUCTION

Wayfinding is the process of determining one's current location and navigating to a desired destination with optimum effectiveness and effortlessly (Fewings, 2001; Brunyé *et al.*, 2010). The design of a built environment is essential to wayfinding. An effectively built environment facilitates understanding and aids people in navigation, hence preserving their sense of direction and orientation (Farr *et al.*, 2012). Medical facilities, particularly hospitals, play a significant role in humanity. Hospital architecture is fundamentally a "basic" form of architecture, as it not only facilitates care and treatment but also fulfils essential architectural functions, including shelter, habitation, and aesthetic enjoyment (Wagenaar and van den Berg, 2006). According to prior studies, hospital visits and wayfinding issues are psychologically challenging; whether visitors are present for personal reasons or due to illness or injury, they are often not there voluntarily and often experience distress, discomfort, and/or anxiety (Berger, 2005; Mollerup, 2008; Carpmann and Grant, 2016). A multitude of variables influence wayfinding. Rooke *et al.* (2010) identified physical properties, coded information, and social practices as the primary dimensions impacting the wayfinding system (Rooke, Koskela, and Tzortzopoulos, 2010a).

Wayfinding in emergency departments has not been extensively studied in the United

Arab Emirates (UAE). No studies in the UAE address the necessity of wayfinding guidelines or parameters to adhere to while constructing an ED. This research analyses the hospital's emergency department (ED) as a case study due to the presence of wayfinding challenges. Firstly, EDs are intricate systems defined by elevated patient traffic, unpredictable patient arrivals, and a diverse array of medical ailments (Ansah *et al.*, 2021; Samadbeik *et al.*, 2024). Diverse patients with limited prior experience are served in EDs under stressful conditions (Ulrich *et al.*, 2008). The ED serves as a vital point of entry to other healthcare systems (Pini, Ralli, and Shanmugam, 2021). Consequently, navigational errors might yield severe consequences for the entire hospital system. This research represents a continuation and expansion of previous work published in the Buildings journal concerning wayfinding in the emergency department (Haj-Saleh and Çağnan, 2025).

Previous research aimed to examine the spatial design in the light of the variable "social practice" and how it influences the wayfinding process, utilizing the software "space syntax" (Haj-Saleh and Çağnan, 2025). However, this research will focus on another variable, "physical properties". Here, the aim is to explore and evaluate the physical properties of transitional spaces from an interior and architectural viewpoint to enhance wayfinding experiences using international standards. Drawing attention to patterns and insights found throughout the case studies that could guide future practice in UAE. Furthermore, this study aims to offer design-oriented recommendations to assist interior designers and architects in enhancing transitional spaces for navigation framing them in the UAE context rather than universal norms.

This research posits that the physical properties of transitional spaces in ED neglect the wayfinding considerations. Therefore, these departments require development approaches that incorporate the concept of wayfinding. The paper will continue on the same case studies, although the methodology differs. Both papers investigate two variables that may contribute to a coherent model which would aid interior designers and architects in optimizing better solutions for ED.

The researchers collected the architectural floor plans from the construction companies in both PDF and AutoCAD formats. Field visits for the three case studies were carried out to closely examine the EDs. Moreover, the researchers observed and captured photos of transitional spaces in each case study. According to the field visits and literature review, the researchers identified the following as the physical properties of transitional

spaces: entrances/exits, pathways, circulation routes, interior design, and landmarks (IHG Part W, 2023). This paper utilized the Wayfinding Transitional Spaces Matrix (WTS-M) to analyse the findings from three samples of emergency departments in the UAE. The Wayfinding Transitional Spaces Matrix contains five wayfinding requirements, derived from the 2023 International Health Facility Guidelines (IHFG). IHFG was selected due to its comprehensive, internationally acclaimed guidelines that tackle healthcare-specific wayfinding challenges across over 50 countries. These guidelines offer measurable criteria that consider a diverse range of user demographics, are easily understandable, and feature a unique interior and architectural approach in their 2023 edition (TAH-PI, 2025). The matrix assesses five physical properties related to transitional spaces. It considers a number of interior architectural features that contribute to the design of physical properties. The research assigns a specific percentage to each physical property based on its consistency with the wayfinding criteria. The five wayfinding requirements for these spaces are identified as: the identification of entrances/exits, well-defined pathways, visual characteristics indicated by landmarks, easy navigation within circulation routes, and to establish a distinct identity through interior design.

Results present localized evidence to inform hospital design and policy development in the UAE. The findings also have practical consequences for architects and interior designers in the UAE hospital system, while providing broader academic value for scholars studying wayfinding and navigation in healthcare environments globally.

LITERATURE REVIEW

• **The Concept of Transitional Space** – Transitional space is a concept employed across several disciplines and manifested in diverse forms (Chun, Kwok, and Tamura, 2004; Pitts and Saleh, 2007, 2007). They are defined as ephemeral locations that serve as delimitations. Boundary positions are typically delineated by ‘barrier’ features, including doors, windows, gates, fences, walls, steps, doorsteps, and various other guardrails (Luz, no date). Transitional spaces include temporary spaces and transit areas that are essential when designing all private and public buildings (Pitts and Saleh, 2007; Al-Ramahi, Iranmanesh, and Denerel, 2023). Another feature of theirs is that they function as a link or connection between two or more areas (Pitts and Saleh, 2007). Furthermore, these spaces are part of the components of exterior and interior buildings, including entrances/exits,

points, lobbies, passageways, corridors, atriums, stairways, and other ancillary spaces (Pitts and Saleh, 2007; Kwong, Adam and Tang, 2009; Luz, no date). Synonymous with “Liminal Spaces”, and “In-Between Spaces” (Cothorn, 2003; Luz, no date), they are characterized either as an independent concept shaped by the surrounding binaries or as an intermediary between two entities that rely on one another. It is a fundamental component of all public edifices and constitutes a considerable portion of their volume (Nassar and El-Samaty, 2007). According to previous studies, the term ‘transition spaces’ is interpreted as a variable based on its function and attributes (Awal, 2022). Another research article identifies these areas as passage spaces, or movement spaces, which influence the distribution and redirection of users (Boettger, 2014).

• **Wayfinding and Hospitals** – Kevin Lynch coined the phrase “wayfinding” in his 1964 book “The Image of the City”, defining it as the process of navigating to a destination using spatial and environmental data (Lynch, 2007). The concept gained prominence in the 1970s, supplanting the phrase “spatial orientation” in scholarly discourse (Arthur and Passini, 1992; Lynch, 2007). Devlin and Bernstein define wayfinding as the process by which individuals orient themselves and navigate spatial settings (Devlin and Bernstein, 1995). In contrast, Passini *et al.* (2000) define wayfinding as an individual’s capacity to mentally visualize or depict a physical environment and to position oneself spatially within that depiction (Passini *et al.*, 2000). Wayfinding is also described by the factors that influence its procedure, referring to a set of tools intended to aid individuals in navigating a novel environment. Knowledge can be acquired from several navigation assistance systems, such as information booths, signage, and maps, in addition to the architectural and spatial features that define an environment (Passini, 1992). This paper asserts that a wayfinding system necessitates the collection of environmental information derived from the architectural features inherent in the built environment. Interpreting a building’s form or configuration may be either arduous or straightforward. The characteristics of structures, complex or not, convey subtle but substantial information: Landmarks, including doorways, elevators, corridors, stairs, and floor finishes, are utilized to navigate to a certain destination (Dogu and Erkip, 2000). Furthermore, the wayfinding method may rely on physical qualities and potential architectural aspects, including entrances, walkways, and circulation systems (Rooke, 2013).

TABLE II THE WAYFINDING REQUIREMENTS BY PHYSICAL PROPERTIES IN TRANSITIONAL SPACES	
Identification of Entrance and Exit	
1	Projection/Recessing
2	Signs
3	Canopy, Portico, or Marquee
4	Symmetry or Asymmetry façade
Well-defined pathway based on interior features	
1	Two parallel continuous long walls
2	Repetitive (columns, lighting, etc.)
3	Floor tone
Visual character created with a landmark	
1	Outstanding (objects, architectural elements, or sculpture)
Easy navigation within circulation routes	
1	Straight movement pattern
2	Linear spatial design
Differentiation of space for distinct identity by interior design	
1	Distinguished (colour, material, texture, style)
2	Furniture setting

Prior research on healthcare architecture indicates that the constructed environment may facilitate healing. Healing architecture is related to the science of medicine, but it is also reflected in other disciplines and theoretical domains, such as sociology, perception theory, environmental psychology, space/place theory, and experiential aesthetics, which means that physical, social, and cultural aspects are important in an architecture capable of supporting health and well-being (Huisman *et al.*, 2012). Wayfinding is an essential concept and should be prioritized throughout the design process. According to studies on the relationship between hospital design and navigating the hospital environment, losing one's way can be a significant cause of the feeling of powerlessness; such difficulty can also generate bodily indicators such as elevated blood pressure and headache, as well as weariness during navigation (Carpman and Grant, 2016).

Rooke, Koskela, and Tzortzopoulos (2010) state that the wayfinding system in medical settings is shaped by three main elements: social practice (such as the roles of staff and volunteers), coded information (such as signage and graphic systems), and physical properties (such as entrance and pathway design; Rooke, Koskela and Tzortzopoulos, 2010). The experience of navigating healthcare facilities is influenced by these interconnected factors taken together. Based on the same case studies in the United Arab Emirates (UAE), this study expands on a previously published work in the *Building Journal* (Haj-Saleh and Çağnan, 2025). The previous study focused on social practices in emergency departments (EDs), emphasizing the spatial connection and visibility of human-related elements such as reception spaces and nurse stations. This research broadens its scope to include physical properties to enhance knowledge and suggest more effective modifications. Collectively, these two studies provide significant insights for improving navigation from both interior design and architecture viewpoints. The third dimension, encoded information, is an interesting domain for further investigation, especially for scholars in graphic and information design.

• **Physical Properties of Transitional Spaces for Wayfinding** – Rooke *et al.* (2009) asserted that an individual's spatial awareness of an area depended on its physical properties and diversity, which might enhance wayfinding independent of instructive signage (Rooke *et al.*, 2009). The visual attributes of the physical setting can be considered as establishing a level of imageability, facilitating the formation of mental representations of the surrounding context, which subsequently

influences individuals' wayfinding (Lynch, 2007). Lawson states that spaces within our ownership or control ought to convey messages through their physical properties. He asserts that this 'human language of space' ought to be an essential instrument for architects (Lawson, 2001). A comparable assertion was made regarding how architectural features and the discernibility of physical properties provide users with wayfinding cues that facilitate intuitive orientation, independent of signage, elucidating the research's reliance on photographic documentation and field observations for physical properties (Ibrahim, 2019). In this research paper, the criteria for evaluating the physical properties of transitional spaces as seen in Table II were constructed from the International Health Facility Guidelines for 2023 for wayfinding. The physical properties are; entrance/exit, pathways, landmarks, circulation routes, and interior design. The table illustrates architectural and interior features that contribute to the design of the physical properties and exhibits the five wayfinding requirements (iHG Part W, 2023).

Entrances and Exits within hospitals are the same. However, identifying an entrance or exit is essential for wayfinding. This criterion can be fulfilled by employing architectural elements to highlight the entry, making it visible and identifiable from afar. The architectural features that facilitate identification include: the projection/recessing of the entrance to give prominence – creating a Canopy, Portico, or Marquee, Symmetry or Asymmetry façade and lastly, Signs (iHG Part W, 2023; Karakurt, 2023). Paths represent the routes within transitional spaces that appear to facilitate wayfinding (Ibrahim, 2019). Pathways must be well-defined for users to have a successful wayfinding experience. The interior features; continuous long walls, the tone of the floor, and repetition (columns, light, etc.) collaborate to establish a pathway design that meets wayfinding needs (iHG Part W, 2023). The term landmark refers to a distinctive visual that serves as a reference point for providing instructions and is easily recalled by both first-time users and returning visitors. Landmarks may be a series of elevators, a courtyard or garden view, outdoor sculptures, an atrium, or other distinctive architectural elements. They are intended to provide a visual representation of the location, hence aiding in wayfinding requirements (iHG Part W, 2023; Karakurt, 2023). Hospital departments/ zones should also be roughly demarcated using simple primitive impressions such as rectangles which would assist in simplifying the circulation of a system of straight corridors between nodes (iHG Part W, 2023). Based on previous

research, this easy-to-navigate wayfinding system can be reached by using a spatial design as a linear organization (Ching, 2012; Zamani, 2019; Natapov *et al.*, 2020; iHG Part W, 2023). Elements of interior design significantly facilitate wayfinding. Design elements, for example, decorations, furniture, lighting, and colour, as well as materials for walls, floors, and ceilings, serve as distinctive aspects of interior spaces that function as navigational cues inside a hospital (Huelat, 2007). Consequently, interior design can establish a unique identity and differentiation of space to simplify the wayfinding task by distinguishing (colour, material, texture, style) and furniture setting (Yesiltepe, 2021; iHG Part W, 2023).

The literature review section explores the concepts of transitional spaces, wayfinding in hospital environments, and physical properties for wayfinding. The section highlights the importance of physical properties to the hospital's wayfinding systems, particularly in emergency departments. The literature review serves as the foundation for the following methodology section, which extracts the matrix from the International Guidelines of Wayfinding in 2023.

METHODOLOGY

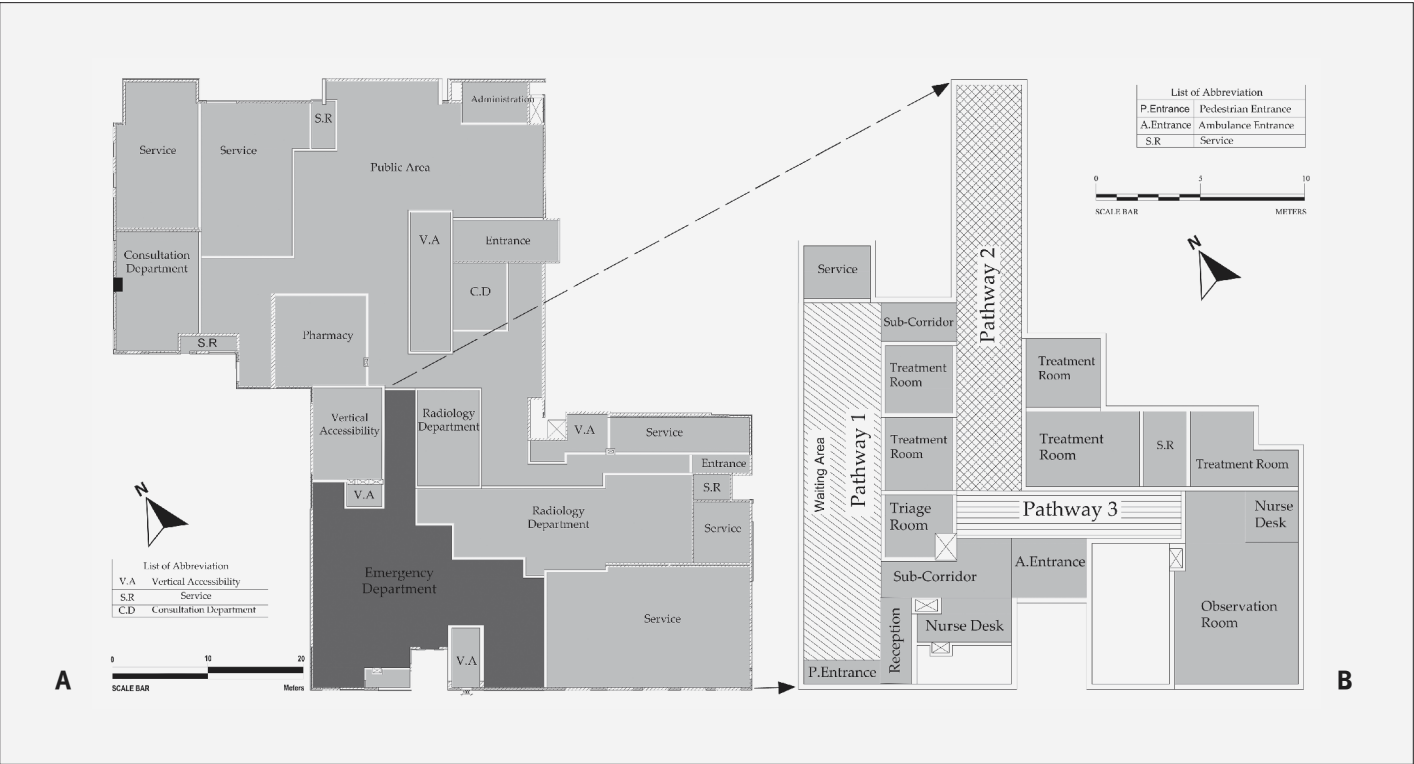
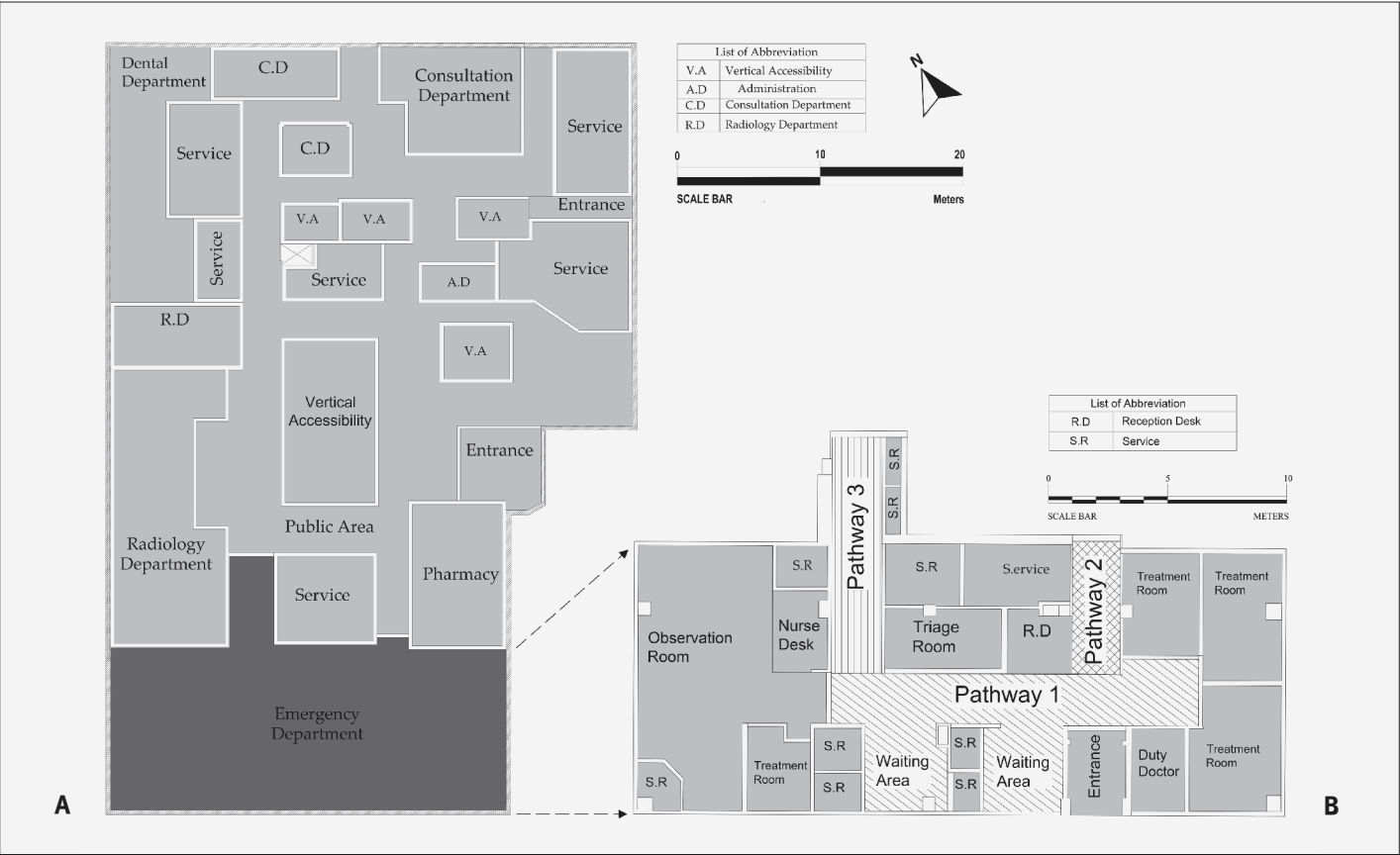
This study employed a qualitative and quantitative approach through a literature review, field visits, observation, and photographic documentation to explore the transitional spaces in EDs. The exploration of the "International Health Facility Guidelines for 2023 for Wayfinding" resulted in the Wayfinding Transitional Space Matrix (WTS-M). This study utilized the WTS-M as a reference for assessing the three selected case studies. In particular, the research focuses on the physical properties of transitional spaces, that is: the entrances/exits, three pathways (one of which includes a waiting area), landmarks, circulation routes, and interior design. It attempts to examine and determine to what extent these physical properties comply with the requirements of the wayfinding guidelines. The WTS-M technique employs a quantitative approach, counting the architectural and interior features and providing a percentage for the presence of each physical property. The evaluation was carried out using standardized, rigorous field observations, which guarantee uniform measurement standards across all facilities utilizing the same observational framework and comprehensive architectural analysis. The Wayfinding Transitional Spaces Matrix (WTS-M) paradigm was employed, offering an objective and systematic approach for examining physical properties pertinent to wayfinding. The ap-

proach and scoring process are elaborated upon in the relevant sections (The Wayfinding Transitional Spaces Matrix). This study presents the data anonymously and does not disclose the identities of individual hospitals for two reasons. First, it ensures the ethical protection of healthcare institutions and prevents any potential reputational concerns arising from the interpretation of results. Second, all hospitals operate under a unified organizational structure and are managed by the same medical operator (Medical Group, UAE). Anonymity allows the research to focus on comparing spatial typologies and wayfinding design within a standardized system rather than across specific locations. This study selected hospitals that exemplify three diverse emergency department layouts within the system, facilitating a comparative analysis of varied spatial arrangements. This allows us to generalize the findings and make them relevant for a broader context of similar healthcare facilities.

In the findings section, the cases describe the presence of attributes in words and photographs. After evaluating the three case studies, the research will compare them to identify which of them possesses physical properties that are most aligned with the wayfinding requirements, and which exhibit least alignment.

CASE STUDIES

This research focused on emergency department as a case study to examine transitional spaces from a wayfinding perspective. Haj Saleh and Çağnan (2025) previously analysed these identical case studies, examining emergency departments (Haj-Saleh and Çağnan, 2025). The research employs a markedly different methodological approach compared to previous studies, albeit utilizing the same three hospitals as case studies, shifting from previous research on social aspects of wayfinding, which utilized space syntax software, to a physical-environmental perspective, utilizing systematic field observations and architectural analysis informed by the WTS-M framework. This transition facilitates the creation of new insights into the spatial and architectural characteristics of transitory zones within emergency rooms. Employing identical case studies guarantees methodological uniformity, facilitating a controlled comparative analysis that incorporates both social and physical dimensions. The method enhances triangulation and facilitates the formulation of more comprehensive design principles for emergency healthcare settings. Furthermore, since this research focuses on the same case studies, it offers significant



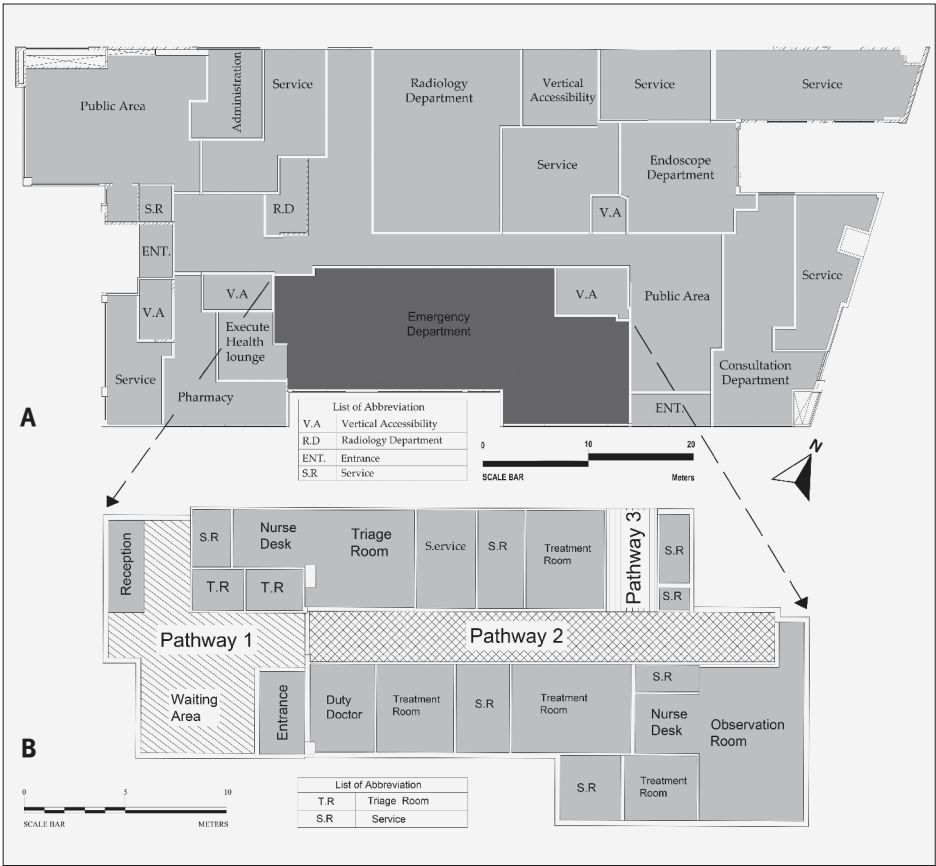
context-specific insights and deepens the understanding of wayfinding difficulties within a cohesive healthcare and urban environment, as the hospitals are located in the United Arab Emirates, where specialized navigation design requirements are lacking.

The three selected case studies are located in the United Arab Emirates (UAE) in the Gulf Area in the Middle East. Dubai and Sharjah are the two emirates where the cases are located. All three cases are private hospitals with 100+ beds, and the ED serves the local district 24/7. Approximately 30,000 patients visit each hospital emergency department annually. The drawings were gathered from the construction companies that built the medical buildings. To maintain discretion and adhere to institutional regulations, the precise names of the hospitals are withheld; the case studies are instead designated anonymously as Case Study A, Case Study B, and Case Study C throughout the research. The subsequent points present broad information regarding the three case studies. The following points provide general information about the three case studies:

- Case study A: located in Dubai in the UAE, 100+ beds in a private hospital that serves the local district. 24/7 in the Emergency departments, with 465 m² area (Fig. 1).
- Case study B: located in Dubai in the UAE, 100 beds in a private hospital that serves the local district. 24/7 in the Emergency departments, with 352 m² area (Fig. 3).
- Case study C: located in Sharjah in the UAE, 100+ beds in a private hospital that serves the local district. 24/7 in the Emergency departments, with 400 m² area (Fig. 2).

THE WAYFINDING TRANSITIONAL SPACES MATRIX

The Wayfinding Transitional Space Matrix (WTS-M) assesses the physical properties in the case studies based on five wayfinding criteria. The attributes of transitional areas where movements transpire are defined by five physical properties: entrance/exit, three pathways (one of them includes a waiting area), landmarks, circulation routes, and interior design. The five wayfinding requirements are: (I) identification of the entrance and exit; (II) definition by interior features for pathways; (III) creating a visual character with a landmark; (IV) easy navigation within circulation routes; and (V) differentiation of space for distinct identity by interior design. The appearance of physical properties depends on the quantity of architectural and interior features that contribute to wayfinding requirements.



The scoring utilized in the WTS-M framework was derived from researchers' systematic field observations and architectural analysis. This guaranteed an impartial and uniform assessment of the physical characteristics affecting wayfinding throughout all case studies. Every physical property has sub-scores resulting from the quantity of existing features. Scores mean: 1 = by indicating with a (✓) sign if present and a (×) sign if not present, these signs were converted to numbers (✓ = 1 and × = 0), to evaluate all of the listed attributes in a specific space where sub-scores were collected resulting in extracted percentages to compare and find the variances. The evaluation on the basis of the wayfinding transitional spaces matrix for three case studies A, B, and C is in Table III.

RESULTS

The quantitative analysis of the matrix was conducted to assess and compare the physical properties of the transitional spaces in the three emergency departments. Scoring in the matrix was based on the presence or absence of specific features, enabling an evaluation of each physical property. Each feature in the matrix contributed one score to the as-

FIG. 3 (A) ED IN THE ARCHITECTURAL PLAN FOR CASE STUDY B, (B) TRANSITIONAL SPACE IN ED IN CASE STUDY B

(PREVIOUS PAGE)

FIG. 1 (A) ED IN THE ARCHITECTURAL PLAN FOR CASE STUDY A, (B) TRANSITIONAL SPACE IN ED IN CASE STUDY A

FIG. 2 (A) ED IN THE ARCHITECTURAL PLAN FOR CASE STUDY C, (B) TRANSITIONAL SPACE IN ED IN CASE STUDY C

TABLE III THE WAYFINDING TRANSITIONAL SPACES MATRIX FOR THREE CASE STUDIES A, B, AND C

Identification of the Entrance and Exit		Case study A			Case study B			Case study C					
		Ent.	Exit	Total	Ent.	Exit	Total	Ent.	Exit	Total			
	Projection or Recessing	×	×	0	✓	×	1	✓	×	1			
	Signs	✓	✓	2	✓	✓	2	✓	✓	2			
	Canopy, Portico, or Marquee	×	×	0	×	×	0	×	×	0			
	Symmetrical or asymmetrical façade	✓	×	1	✓	×	1	✓	✓	2			
	Sub scores	2	1	3	3	1	4	3	2	5			
	Total in percentage	37.5%			50%			62.5%					
Well-defined pathway based on interior features		Pathway 1	Pathway 2	Pathway 3	Total	Pathway 1	Pathway 2	Pathway 3	Total	Pathway 1	Pathway 2	Pathway 3	Total
	Continuous long wall	✓	✓	✓	3	×	✓	✓	3	✓	✓	✓	3
	Repetitive (handrail, lighting, etc.)	✓	✓	✓	3	✓	✓	✓	2	✓	✓	✓	3
	Floor tone	×	×	×	0	×	✓	✓	2	✓	×	×	1
	Sub scores	2	2	2	6	1	3	3	7	3	2	2	7
	Total in percentage	66.7%			77.8%			77.8%					
Visual character created with a landmark		Pathway 1	Pathway 2	Pathway 3	Total	Pathway 1	Pathway 2	Pathway 3	Total	Pathway 1	Pathway 2	Pathway 3	Total
	Outstanding (objects, or sculpture)	×	×	×	0	×	×	×	0	×	×	×	0
	Sub scores	0	0	0	0	0	0	0	0	0	0	0	0
	Total in percentage	0%			0%			0%					
Easy navigation within circulation routes		Circulation Plan		Total	Circulation Plan		Total	Circulation Plan		Total			
	Straight movement pattern	✓	1		✓	1		✓	1				
	Linear spatial design	✓	1	✓	1	✓	1						
	Sub scores	2	2	2	2	2	2	2					
	Total in percentage	100%		100%		100%							
Differentiation of space for distinct identity by interior design		Pathway 1	Pathway 2	Pathway 3	Total	Pathway 1	Pathway 2	Pathway 3	Total	Pathway 1	Pathway 2	Pathway 3	Total
	Distinguished (colour, material, texture, style)	×	×	×	0	×	×	×	0	✓	×	×	1
	Furniture setting	✓	×	×	1	✓	×	×	1	✓	×	×	1
	Sub scores	1	0	0	1	1	0	0	1	2	0	0	2
	Total in percentage	16.7%			16.7%			33.4%					

Key of the matrix: 1 = by indicating with a (✓) sign if present and a (×) sign if not present, these signs were converted to numbers (✓ = 1 and × = 0)

essment, resulting in a calculated percentage for the extent of physical property presence, as presented in Chart I.

The comparative analysis of the three case studies examines five physical properties in transitional spaces. Entrance/exits show the following results from Case study A (37.5%), to B (50%), to C (62.5%), indicating enhanced identification. The pathways are well defined across all cases, with Case A at 66.7% and both Cases B and C achieving 77.8%. Interior design elements demonstrate identical metrics in Cases A and B (16.7%), while Case C shows significant improvement (33.4%). Remarkably, circulation routes exhibit 100% performance in every scenario, demonstrating movement patterns that improve easy navigation. Nevertheless, landmarks exhibit a persistent absence (0%) throughout all trials, highlighting a distinct opportunity for enhancement. Case study C exhibits exceptional performance across most parameters, especially in entrance/exit identification and distinguished identity by interior design.

FINDINGS AND DISCUSSION

In this section, the findings from the three case studies will be presented and explored. The physical properties within the transitional spaces for the three case studies discussed in this article are: The entrance/exit and three pathways, with one of the pathways open to the waiting area, landmarks, circulation routes, and interior design. The numeric findings come from the (WTS-M) in Table I.

CASE STUDY A

The architectural features of the Entrance and Exit that contributed to identifying the entrance were two: a red illuminated sign indicating the department’s name and a symmetrical-appearing façade. For the exit door, a green illuminated sign was hung above it (Fig. 4). A total sub-score of 3 out of 8 features contributes to identifying the entrance and exit in this case study, with a percentage of 37.5% (IHFG Part W, 2023).

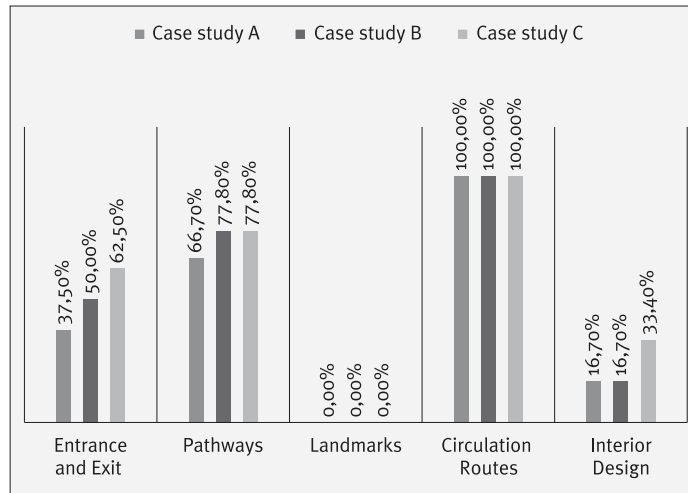
The emergency department contains three pathways. The interior features that contributed to defining the pathways were; the repetition of lighting in the ceiling, the continuous handrail hanging on the wall, and long parallel walls. The colour scheme of the pathway floor was in harmony with the rest of the colours used. Therefore, the tone of the floor did not create any distinctive feature for the pathway. The total sub-score was 6 out of 9 for the paths with a percentage of 66.7% (IHFG Part W, 2023). The landmark element was entirely omitted. The interior of the transitional pathways lacked landmarks (Fig. 6).

Resulting in an absence of remembered images or visual cues for navigation; thus, the total sub-score is 0, equating to 0% (Dinata and Wijono, 2020; iHFG Part W, 2023.; Karakurt, 2023).

The movement pattern consists of straight lines due to a rectangular spatial arrangement, resulting in a circulation route characterized by linear organization (Fig. 7). The overall thematic core has two out of the two features, resulting in a 100% alignment with the navigational and wayfinding criteria established by numerous studies and standards (Ching, 2012; Zamani, 2019; Natapov *et al.*, 2020; iHG Part W, 2023).

Interior design, the transitional space has one identity. The style, colour scheme, lighting system, and flooring were all in the modern style, which means the differentiation of space was missing, except for a pathway (3) which included the waiting area with furniture (a set of sofas; Figs. 5 and 6). The three pathways in total scored 1 out of 6, indicating a percentage of 16.7% (Ibrahim, 2019; iHG Part W, 2023; Yesiltepe, 2021).

Chart II delineates the variables of physical properties, including their percentages depending on the quantity of architectural and interior features identified following the assessment of the transitional space in the WTS-M, while the figures display all documented photographs of transitional spaces within the emergency departments of case study A.



CASE STUDY B

The emergency department entrance is set back from the main street within a secondary facade, making it less visible. The entrance is marked by a projecting element in the facade, which shelters the entry. A red sign clearly identifies the department.

The asymmetrical form of the facade is further emphasized by the materials used in its construction. The exit is marked by a green-lit sign (Fig. 8). Both the entry and exit possess 4 out of 8 features, representing a 50% presence (Dalke *et al.*, 2013; iHG Part W, 2023).

CHART I COMPARATIVE ANALYSIS OF THE PHYSICAL PROPERTIES EVALUATED IN THE MATRIX

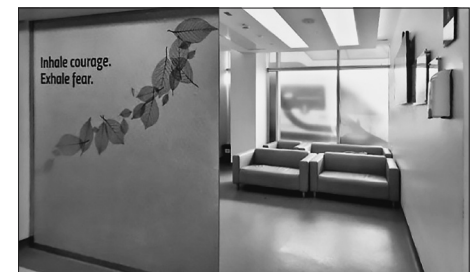


FIG. 4 (A) ENTRANCE: 1. RED SIGN, 2. SYMMETRICAL FAÇADE; (B) EXIT: 3. GREEN SIGN

FIG. 5 (G) WAITING AREA IN PATHWAY 1: 1. FURNITURE SETTING



FIG. 6 (C,D,E) 1. REPETITION IN LIGHTING AND HANDRAIL, 2. PARALLEL WALLS

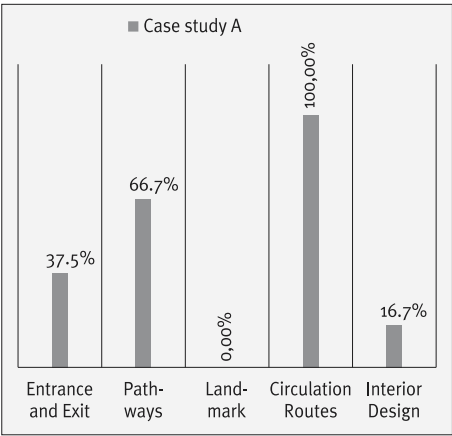
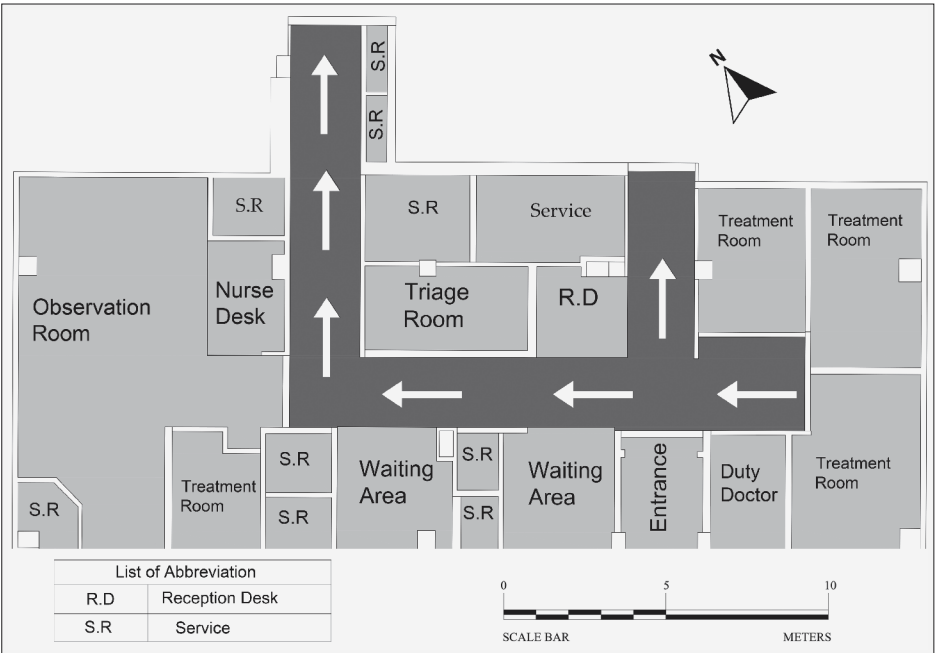


FIG. 7 (F) CIRCULATION PLAN: 1. LINEAR LAYOUT, 2. STRAIGHT MOVEMENT PATTERN

CHART II FINDINGS OF PHYSICAL PROPERTIES EVALUATED IN THE MATRIX – CASE STUDY A

The department is comprised of three paths. The initial corridor, which encompasses the waiting area, lacked parallel walls, and the flooring’s hue harmonized with the surrounding hues, leaving it devoid of any distinctive elements. The sole interior feature was the repetitive lighting system. The second and third pathways are characterized by several interior features, including elongated parallel walls, repetitive railings and lighting, and a contrasting floor colour (Fig. 9). The paths were delineated by 7 of the 9 features, achieving a percentage of 77.8% (Dalke *et al.*, 2013; iHG Part W, 2023). The location lacked any visually recognizable landmarks, and no objects were utilized to assist in navigation or orientation within the emergency department (Fig. 9). Resulting in a total score of 0 in contributed features (Dinata and Wijono, 2020; iHFG Part W, 2023.; Karakurt, 2023) .

Circulation routes, with the total features that worked together being two, achieved a 100% alignment with the navigational and wayfinding requirements set by various studies and standards. Because of its rectangular physical arrangement, the movement pattern is made up of straight lines, creating a circulation route with a linear organization (Fig. 10; Ching, 2012; Zamani, 2019; Natapov *et al.*, 2020; iHG Part W, 2023).

Wayfinding criteria necessitate that interior design differentiates between various sections and internal spaces. This sector was overlooked as the design was internally cohesive, lacking distinguishing stylistic as-

pects. However, in the pathway (1), which includes the waiting room, the furniture arrangement is notable (Figs. 9 and 11). Consequently, the overall sub-score is 1 out of 6, equating to 16.7% (Ibrahim, 2019; iHG Part W, 2023; Yesiltepe, 2021).

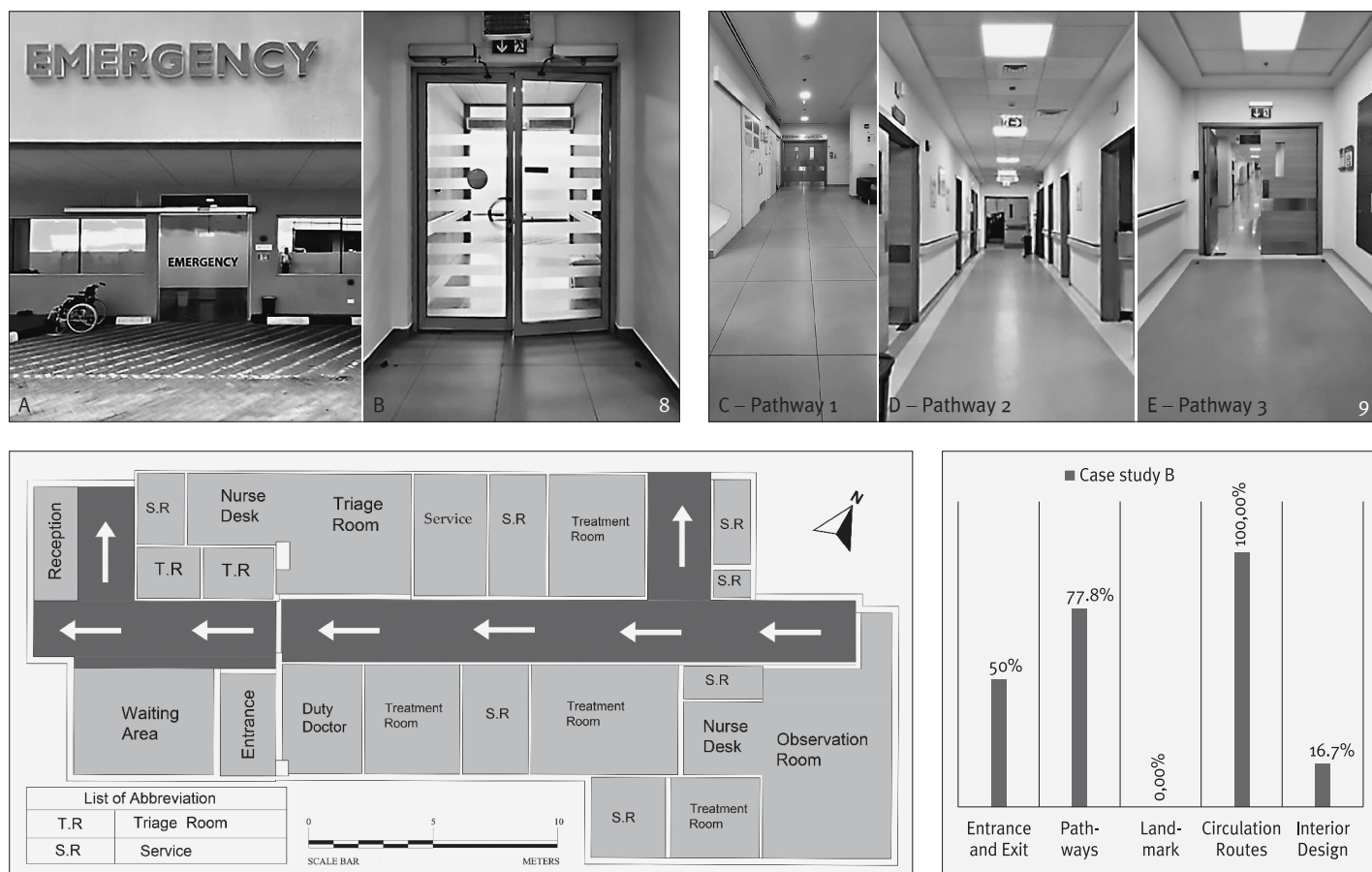
Chart III illustrates the variables of physical properties, including their percentages, based on the quantity of architectural and interior features identified after assessing the transitional space in the WTS-M, while figures present all recorded photographs of the transitional spaces within the emergency departments of the case study B.

CASE STUDY C

There are two entrances to the emergency department on one façade of the hospital building. One is for pedestrians and the other for the ambulance. The architectural features identifying the entrances are: a projection, signs, and an asymmetrical façade in the used material. The pedestrian entrance façade was covered with a stone tile material whose colour and texture is completely different from the rest of the hospital façade. The material of the door itself was glass, contrasting with the material of the wall where the door is located. The glass was also marked by a printed sign with a distinctive green colour to indicate the entrance. The Ambulance Entrance is in a recessed part of the building’s façade. The façade has a smooth aluminium material and a white-silver colour, contrasting with the material of the adjacent façade. Finally, a red sign displaying the name is hung above the two entrances. Exits are indicated by a green sign that was hung over the door (Fig. 12 a,b,c).

The total sub-score is 5 out of 8 features with a 62.5% percentage, coming in as the highest result among the three case studies (Dalke *et al.*, 2013; iHG Part W, 2023).

The emergency department in the third case study contains three main pathways. The architectural features that define the first path are two long parallel walls, repetitive lighting, furniture, and handrails fixed along the two walls as well as a distinct tone of the floor. The second and third pathways contain long parallel walls, repetitive lighting, and a handrail. They score seven out of nine features with 77.8% (Dalke *et al.*, 2013; iHG Part W, 2023). As for the landmarks, there were no distinctive landmarks (Fig. 13 d,e,f). The space had a unified character without any unexpected objects, scoring 0 and reflecting 0% (Dinata and Wijono, 2020; iHFG Part W, 2023.; Karakurt, 2023).



The spatial layout reflects a linear circulation arrangement with simple straight paths (Fig. 14 g). Achieving 100% with a total of 2 scores (Ching, 2012; Zamani, 2019; Natapov *et al.*, 2020; iHG Part W, 2023).

In this case study, the first pathway where the waiting area is located has achieved both features (distinguished by colour, material, texture, and furniture setting). The wall texture, colours, lighting, and furnishings exhibit a distinctive character that sets it apart from other transitional areas (Fig. 13 d). Conversely, pathways 2 and 3 present an identity devoid of distinction in material, style, or colour (Fig. 13 e,f). Hence, the interior design physical property has achieved two out of the six features required in transitional spaces, set at 33.4% (Ibrahim, 2019; iHG Part W, 2023; Yesiltepe, 2021). Chart IV depicts the variables of physical properties, including their percentages derived from the quantity of architectural and interior features identified following the evaluation of the transitional space in the WTS-M, whereas figures displays all documented photographs of the transitional spaces within the emergency departments of case study C.

LIMITATIONS AND FUTURE RESEARCH

Comparable to the majority of research, the present research methodology contains limitations that create opportunities for further investigation. This study has recognized that the wayfinding system is a complex human behaviour that is influenced by a variety of inputs and variables. This study aligns thematically with a prior examination on the social dimensions of navigation in emergency departments; however, it diverges in both methodology and conceptual framework. The previous research utilized the space syntax tool, highlighting variables related to social practices (Haj-Saleh and Çağnan, 2025). This study employs architectural analysis through the Wayfinding Transitional Spaces Matrix (WTS-M), designed to evaluate variables related to physical properties, including entrances/exits, pathways, landmarks, circulation, and interior design. It is essential to highlight that, although both studies investigated the same three emergency departments, they had distinct analytical objectives. The employment of identical case studies in both publications facilitates methodological triangulation, thereby enhancing

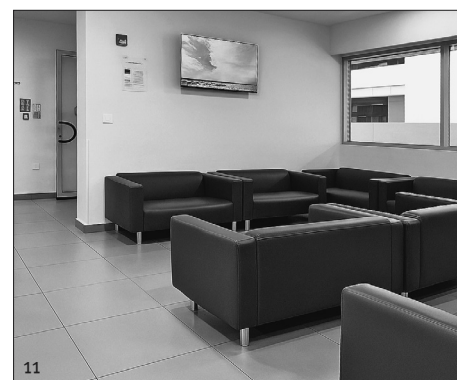


FIG. 8 (A) ENTRANCE: 1. PROJECTION, 2. RED SIGN, 3. ASYMMETRICAL FAÇADE; (B) EXIT: 1. GREEN SIGN

FIG. 9 (C) 1. REPETITIVE IN LIGHTING; (D,E) 1. PARALLEL WALLS, 2. REPETITIVE IN LIGHTING AND HANDRAIL, 3. CONTRAST IN FLOOR TONE

FIG. 10 (F) CIRCULATION PLAN; 1. LINEAR LAYOUT, 2. STRAIGHT MOVEMENT PATTERN

CHART III FINDINGS OF PHYSICAL PROPERTIES EVALUATED IN THE MATRIX – CASE STUDY B

FIG. 11 (G) WAITING AREA IN PATHWAY 1: 1. FURNITURE SETTING



FIG. 12 (A) ENTRANCES: PEDESTRIANS ENT. LEFT SIDE, RIGHT SIDE AMBULANCE – ENT. BOTH HAVE: 1. PROJECTION, 2. RED SIGNS, 3. ASYMMETRICAL FAÇADE IN MATERIAL; (B) PEDESTRIANS EXIT, (C) AMBULANCE EXIT – EXITS: 1. GREEN SIGN

FIG. 13 (D) PATHWAY 1: 1. PARALLEL WALLS, 2. REPETITIVE IN LIGHTING AND HANDRAIL, 3. CONTRAST IN FLOOR TONE, 4. FURNITURE SETTING; (E) PATHWAY 2, (F) PATHWAY 3 – (E,F) PARALLEL WALLS, 2. REPETITIVE IN LIGHTING AND HANDRAIL

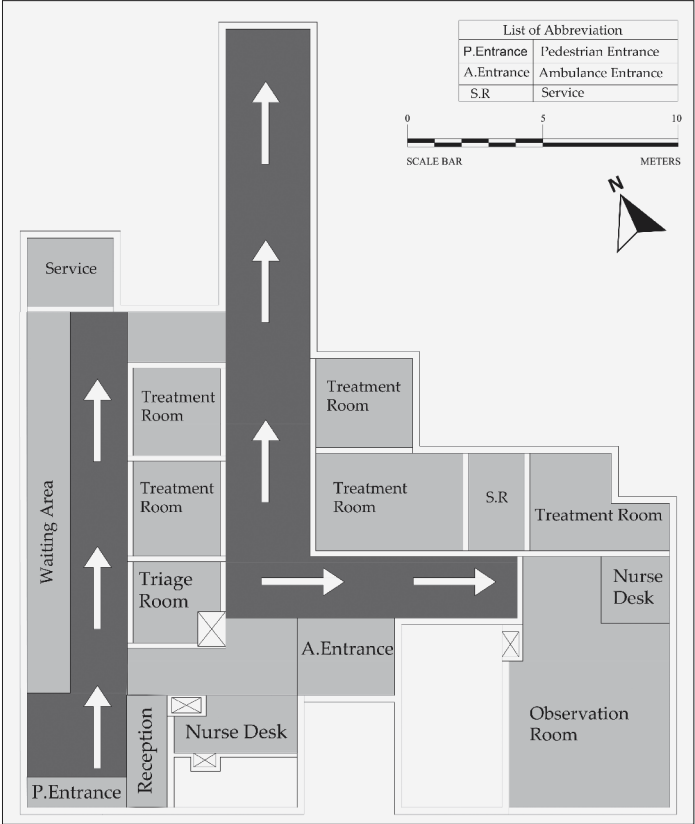


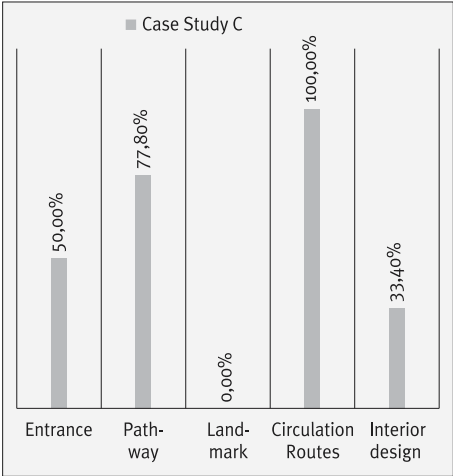
FIG. 14 (G) CIRCULATION PLAN: 1. LINEAR LAYOUT, 2. STRAIGHT MOVEMENT PATTERN

CHART IV FINDINGS OF PHYSICAL PROPERTIES EVALUATED IN THE MATRIX – CASE STUDY C

the knowledge of wayfinding in transitional areas. Certain constraints and recommendations may seem analogous, such as the necessity for a more extensive case study sample or additional qualitative investigation; yet, they underscore enduring and pervasive issues recognized through various analytical perspectives.

Subsequent research may expand upon the methodological framework of this study by implementing the Wayfinding Transitional Spaces Matrix (WTS-M) in a wider array of healthcare environments, such as inpatient wards or outpatient clinics, to evaluate its adaptability and generalizability. Furthermore, incorporating the WTS-M with digital tools like Building Information Modelling (BIM) or real-time wayfinding simulations could improve its accuracy and use in initial design stages.

A significant limitation of the current study is its inadequate exploration of the lived experiences of users. The study conducted a comprehensive analysis of spatial configurations but did not include real-time behavioural observations or cognitive feedback. Subsequent studies ought to incorporate a variety of approaches, including path mapping with broad user demographics and ethnographic observation, to elucidate the emotional, cognitive, and experiential facets of wayfinding. The study's limitations include the absence of surveys, which hinders the ability to document users' subjective experiences. Instead, it focuses on objective evaluation of physical and spatial characteristics, a crucial initial step for user-centered research. Future studies may incorporate social and experiential aspects. Furthermore, broadening the focus beyond emergency departments to encompass additional transitional healthcare environments across diverse cultural and institutional settings would facilitate the creation of



more universally applicable and resilient design concepts. Additionally, future research may be obtained by examining how navigation is impacted by cultural landmarks or symbolic cues unique to the United Arab Emirates, especially when contrasting local design approaches with Western hospital models. Incorporating cultural factors with architectural and spatial elements will facilitate a comprehensive understanding of wayfinding, acknowledging that navigating in healthcare settings is influenced by both physical and social circumstances.

These constraints must be acknowledged while analysing the results. Nevertheless, the physical insights obtained from the WTS-M framework enhance the broader domain of healthcare design and illustrate the importance of environmental signals in influencing user navigation within the UAE context.

CONCLUSION

The current development of the WTS-M focuses on examining the physical properties of transitional spaces in emergency departments in the UAE. It aims to provide designers with a framework for integrating and evaluating these properties in light of wayfinding requirements within the UAE context. This paper suggests that designing the physical properties of transitional locations – such as entrances/exits, paths, landmarks, circulation routes, and interior design – serves as part of a complex system that affects the wayfinding during the various phases of building design.

The building's bulk and façade design influence the configuration of the entrance. Furthermore, the spatial design drawings, which serve as initial drawings for building design, create the circulation routes. In the later phases of emergency department design, interior finishes and landmarks can help resolve issues in transitional areas that affect wayfinding requirements, such as using contrasting textures to create distinct identities for each pathway. On the other hand, incorporating a prominent landmark into the pathway can enhance the wayfinding process. Architects and interior designers ought to participate in the planning and evaluation of these physical property designs as one of the wayfinding solutions during the phases of emergency department design, rather than

relegating this responsibility solely to graphic designers, as is typically practiced in sign design.

The following points present a model for the physical properties of transitional spaces in emergency departments in the UAE, accompanied by supporting visuals. This study articulates its recommendations as context-specific guidelines, not universally applicable standards, based on the analysis of case studies, which seek to enhance the current discourse on wayfinding in hospital settings, specifically within the context of the UAE. Patterns identified in the architectural and spatial arrangements of transitional spaces in emergency rooms could potentially facilitate more intuitive navigation; however, these should not be construed as prescriptive design guidelines. This research establishes a basis for comprehending the impact of spatial configurations on wayfinding in high-stress emergencies and serves as a preliminary framework for practitioners and scholars to investigate more comprehensive design solutions. The visuals can be seen in Table I:

- The entrances and exits have four features that can continue to create an identification property: An asymmetrical façade in shape or material, a recess in the façade that can create a canopy, and a red sign carrying the name of the emergency department, together with a green sign indicating the Exit.
- Pathways should be designed with two parallel walls with a repetitive lighting system and a continuous handrail, and lastly, a distinguished floor tone that creates a contrasting view with the walls and ceiling
- Each pathway's interior design should possess a distinct personality through the utilization of specific colour themes or materials. Similar to landmarks, a memorable sign should be employed to generate a distinctive indication for each pathway, for instance, the green pathway with a suspended clock.
- The emergency room layouts that utilized linear spatial configurations with direct, straight circulation routes (e.g. rectangular layouts with perpendicular corridors) reduce wayfinding challenges, as per the guidelines. This indicates that linear planning serves as both a design principle and a vital element for improving wayfinding within the UAE healthcare system.

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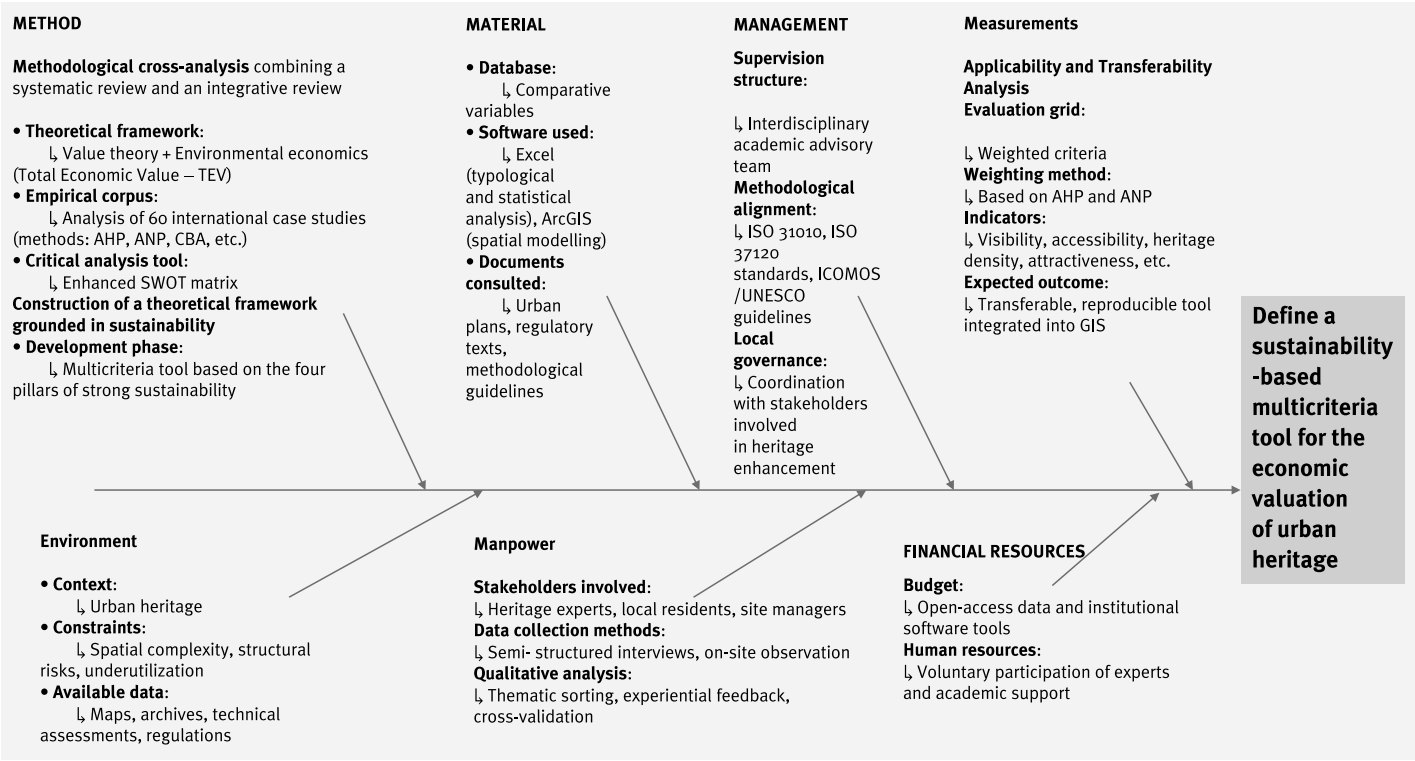


FIG. 1 METHODOLOGICAL FRAMEWORK DIAGRAM (BASED ON THE ISHIKAWA 7M MODEL)

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ECONOMIC VALUATION OF URBAN HERITAGE MODELLING AN INTEGRATIVE FRAMEWORK BASED ON SUSTAINABILITY PRINCIPLES

ECONOMIC VALUATION
INTEGRATED MANAGEMENT
MULTICRITERIA METHODOLOGY
SUSTAINABILITY
URBAN HERITAGE

In response to the increasing complexity of urban heritage management, this study proposes an analytical framework that integrates sustainability theory with multicriteria approaches to economic valuation. A systematic and integrative literature review was conducted, drawing on over sixty documented international case studies. These cases reveal dominant methodological trends, their application contexts, and the strengths and limitations of the valuation tools employed. The critical analysis distinguishes classical monetary approaches from more systemic methods that incorporate social, cultural, and environmental

dimensions. The need to move beyond purely economic logics by integrating strong sustainability criteria and often overlooked qualitative indicators is highlighted in the study. Based on this diagnosis, a multicriteria economic valuation method rooted in sustainability is identified as the most appropriate. The research culminates in the development of an analytical grid encompassing both tangible and intangible factors, aimed at supporting informed decision-making in the valorization and planning of urban heritage. The proposed method is characterized by its adaptability to complex heritage urban contexts.

INTRODUCTION

Historic urban centers constitute complex socio-spatial systems whereby architectural, cultural, and economic dimensions converge. Their long-term preservation presents critical issues of governance, particularly regarding the strategic allocation of limited public resources in rapidly evolving urban environments. In this context, economic valuation has gained traction as a key instrument to assess the multifaceted benefits, both tangible and intangible, associated with the safeguarding of historical assets (Licciardi, Amirtahmasebi, 2012; World Bank, 2012a). Beyond conventional indicators such as tourism revenue or land value appreciation, historic city cores are increasingly recognized for their diffuse yet substantial contributions to territorial cohesion, symbolic continuity, and spatial attractiveness (World Bank, 2012b; Kyte, 2012).

Nevertheless, conventional valuation practices often struggle to capture these multidimensional values. Due to its hybrid nature, urban heritage encompasses intertwined economic, cultural, social, and symbolic dimensions (UVSQ, 2012a). Traditional cost-benefit analysis tools frequently prove inadequate for addressing the complexity and non-market positive externalities inherent to heritage systems (Rypkema, Cheong, 2011). This limitation has fostered the emergence of more integrative approaches drawing upon environmental economics and multicriteria decision-making methods (Dalmas et al., 2014).

Among these, the Total Economic Value (TEV) framework (originally developed for ecological assets) has progressively been adapted to cultural heritage. By differentiating direct use values, indirect externalities, and non-use values such as existence or bequest, TEV provides a more comprehensive architecture for economic assessment (Dalmas et al., 2014). However, its operationalization remains fraught with challenges: the monetization of intangible goods, the reliability of stated preference methods, and ethical questions concerning the commodification of heritage all complicate implementation (Pujol-Galindo, 2024).

In response, international institutions have increasingly advocated for the integration of cultural dimensions into sustainable urban development models. The World Bank, for instance, has documented several cases in which heritage rehabilitation contributed to inclusive local growth by combining preservation, economic vitality, and quality of life (World Bank, 2012c). This recognition has encouraged the development of novel evaluation methods blending monetary and non-monetary indicators (UVSQ, 2012b; Dalmas et al., 2014).

The present study aligns with this perspective. It proposes an analytical framework grounded in a multicriteria reading of heritage value, drawing on sustainability indicators and principles from environmental economics (Fig. 2). Particular emphasis is placed on the distinction between heritage capital as stock and heritage services as flows, alongside the concept of strong sustainability, whereby certain cultural assets are considered non-substitutable (Dalmas et al., 2014). The overarching objective is to move beyond strictly monetarist approaches by offering public decision-makers a context-sensitive evaluation tool tailored to the complexity of urban heritage systems.

METHODOLOGY

The methodology adopted in this research follows a rigorous four-step process, building on a theoretical framework rooted in the convergence of Total Economic Value (TEV) theory and environmental economics (Throsby, 2012; Dalmas et al., 2014; World Bank, 2012a). The main objective is to develop a multicriteria tool for the economic valuation of urban heritage, particularly suited to complex contexts such as historic city centers. The methodological framework highlights the paradox of a normative yet fragmented corpus: while dominant approaches demonstrate operational effectiveness, they often fail to integrate the crosscutting imperatives of strong sustainability (Soini, Dessein, 2016).

The emergence of critical approaches that combine qualitative assessment with integrated indicators opens new perspectives for redefining heritage value beyond strictly economic metrics. The methodology, combining value theory, environmental economics, a critical review of existing valuation methods, and the design of a multicriteria grid based on strong sustainability principles, constitutes a robust and multidimensional analytical framework (Fig. 1).

• **Theoretical convergence:** Value theory and environmental economics – The first phase consisted of building a hybrid conceptual framework by merging insights from value theory as applied to heritage (including use values, non-use values, existence and bequest values) with non-market valuation tools from environmental economics (contingent valuation, avoided cost methods, hedonic pricing, etc.). This theoretical convergence allows for a more comprehensive understanding of urban heritage value, extending beyond market-based assessments (Fig. 2).

• **Construction of an empirical corpus** of 60 documented cases – A structured corpus of 60 international case studies was compiled (Table I), covering rehabilitation or enhancement initiatives in historic urban areas, documented both methodologically and contextually. This database was used as the empirical foundation for identifying dominant configurations in economic heritage valuation. Each case was analysed using a matrix of criteria that synthesized the nature of the method applied (monetary, multicriteria, hybrid), the tools mobilized (surveys, modeling, GIS, etc.), the dimensions emphasized (economic, social, cultural, environmental), and the observed effects (territorial attractiveness, social inclusion, identity reinforcement). Through cross-tabulation in Excel, comparative typologies were extracted, enabling the identification of recurring methodological trends. These findings informed the critical stance adopted in the study and guided the construction of a valuation model tailored to the requirements of both urban heritage and sustainability. Data from the 60 international case studies were processed in Excel to classify variables, perform descriptive statistics, and construct comparative matrices. ArcGIS supported the spatial mapping and validation of analytical criteria, reinforcing the empirical consistency of the multicriteria framework. Furthermore, the selected criteria were weighted through the Analytic Hierarchy Process (AHP). This systematic approach allowed for the prioritization of evaluation dimensions and led to the formulation of a coherent and concise set of sustainability indicators within the analytical grid.

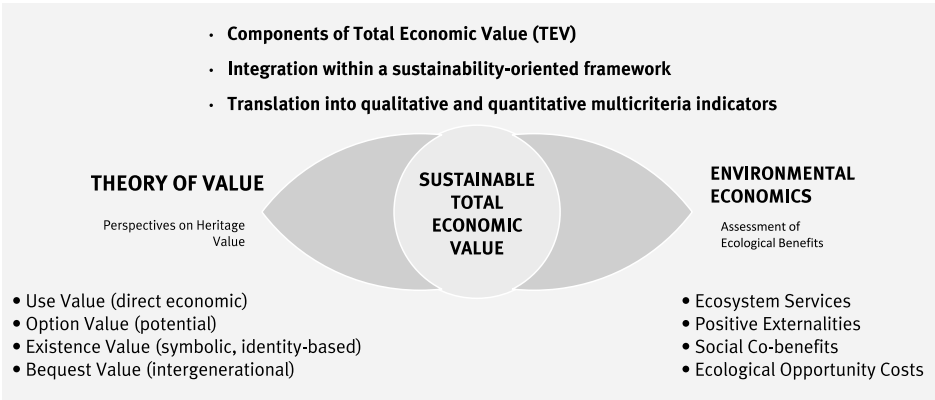


FIG. 2 CROSS-CONCEPT MAP: THEORETICAL INTERSECTION BETWEEN VALUE THEORY AND ENVIRONMENTAL ECONOMICS

• **Critical review** of existing methodologies – A critical evaluation of the approaches identified was conducted using a tailored SWOT analysis, enabling the identification of strengths, weaknesses, opportunities, and limitations across major methodological families:

- Purely monetary approaches provide direct measurement but tend to reduce heritage complexity to financial flows.
- Participatory approaches enrich decision-making but often lack standardization.
- Multicriteria approaches capture qualitative dimensions, but their robustness depends on the weighting of indicators.

The choice of the SWOT framework (Table II-V) lies in its ability to synthesize internal and external factors and to support a comparative analysis. In this study, SWOT (Strengths, Weaknesses, Opportunities, and Threats) served as a strategic decision-making tool for assessing the relative merits and limitations of various heritage valuation methods. Although originally derived from strategic management (Wehrich, 1982), SWOT analysis

TABLE I DISTRIBUTION OF CASE STUDIES BY CONTINENT	
Continent	Cases
Europe	“Arab Tower” (Spain); Archaeological Park of Paestum (Italy); British Museum (United Kingdom); Bulgarian Monasteries (Bulgaria); Cartagena (Murcia, Spain); Chartwell, Stourhead, and Upton (England); Four Sites in Castile (Spain); Heritage Buildings (Moldova); Historic Center of Bucharest (Romania); Island of Sant’Erasmus (Venice, Italy); Lincoln Cathedral (United Kingdom); Museums of Stockholm (Sweden); “Napoli Musei Aperti” (Italy); National Museum of Sculpture & Patio Herrero (Valladolid, Spain); Noto (Sicily, Italy); Old Nice (France); Pergamon (Turkey); Royal Theatre (Denmark); Temple of Poseidon (Greece); Titanic Quarter (Northern Ireland); Tullin Block – Urban Heritage (Oslo, Norway); Various Urban Heritage Sites (Europe).
Americas	Caminito Street (Buenos Aires, Argentina); Fort San Cristóbal (Puerto Rico); Historic Center of Quito (Ecuador); La Plata Museum (Argentina); Machu Picchu (Peru); Victorian House of Lewiston (USA).
Africa	Historic Center of Saïda (Lebanon, extended North Africa); Lake Tana (Ethiopia); Mar Mikhael District (Beirut, Lebanon – Africa / Middle East region); Medina of Fez (Morocco); Old Residence (Calabar, Nigeria – two cases); Saint-Louis, Historic City (Senegal); Tunis (Tunisia); Morocco (Generic Case).
Asia	Ankara Castle (Turkey); Changdeokgung Palace (Seoul, South Korea); Fouad Boutros Highway Project (Beirut); FRIM National Heritage Site (Malaysia); Georgetown Waterfront (Penang, Malaysia); Hoi An (Vietnam); Li River (China); My Son Sanctuary (Vietnam); Shat Gombuj Mosque (Bangladesh); Historic Temples (Thailand, ten detailed cases).
Oceania	Australian Study on Heritage Site Valuation (Australia).

TABLE II COST-BENEFIT ANALYSIS (CBA)

Strengths	Weaknesses
- Standardized and well-recognized framework: the Machu Picchu case demonstrates that well-structured pricing can sustainably fund conservation. - Cross-sector comparability: the Fouad Boutros highway project in Beirut enabled effective comparison with other infrastructure investments. - Clear monetary outputs: Machu Picchu’s rehabilitation exhibited measurable self-financing through ticket revenues.	- Intangible values are often omitted, as in the case of Saïda’s historic centre. - Non-use values are poorly addressed: for example, significant value of San Cristóbal fortress remains unaccounted. - Heavy reliance on speculative counterfactual scenarios.
Opportunities	Threats
- Gradual integration of intangible components: Cartagena’s evaluation already includes ecosystem services of heritage walls. - Potential to incorporate sustainability thresholds into CBAs, as exemplified by Saint Louis, Senegal.	- Risk of reducing heritage assets (e.g., Noto) to short-term profitability. - Discounting practices may prioritize immediate gains over patrimonial longevity.

Revealed Preference Methods (Hedonic Pricing, Travel Cost)	
Strengths	Weaknesses
- Based on observed behaviour: e.g., property premium in Old Nice and recreation surplus at the Poseidon temple. - Robust econometric tools.	- Limited to direct use values: attachment to Fès Medina remains unexamined due to lack of market structure. - Access to price or visitation data can be challenging, as in pre-cadastre Bucharest.
Opportunities	Threats
- Increasing digitization of real estate and tourism databases; GIS-enhanced calibrations already tested in Pergamon. - Potential for designing local heritage taxation (Nice).	- Risk of conflating correlation with causation; e.g., rising rents in Titanic Quarter not solely due to heritage-related prestige. - Policy-related and symbolic values may remain hidden.

Stated Preference Methods (Contingent Valuation, Discrete Choice)	
Strengths	Weaknesses
- Only approach fully capturing non-use values: e.g., expressed attachment to Noto’s reconstruction or the Royal Theatre. - Flexible design: local surveys (Naples “Musei Aperiti”) or international contexts (Changdeokgung).	- Dependent on respondent honesty; strategic bias identified in Sant’Erasmus survey. - Scenario abstraction may reduce realism, as occurred in Thai temple studies.
Opportunities	Threats
- Integration with participatory visualisation enhances scenario comprehension. - Combined with conjoint analysis; Paestum case revealed marginal values for heritage services.	- Public credibility risk if WTP estimates appear unrealistic (Hoi An case). - Results are highly sensitive to survey design.

TABLE III SUSTAINABILITY-BASED MULTICRITERIA APPROACHES (AHP, ANP, GIS GRIDS)

Strengths	Weaknesses
- Holistic perspective: Tunisian study combined economic, social, cultural, and environmental indicators. - Broader stakeholder participation: workshops in Saint Louis involved officials, residents, and experts. - Consideration of irreversibility: investment thresholds tested patrimonial vulnerability.	- Complex parameterisation: successive AHP iterations needed to stabilise weights in Lviv. - Translating results into rapid budget decisions can be challenging.
Opportunities	Threats
- Alignment with SDGs and support from agencies like UNESCO and World Bank; Quito implementation illustrates compatibility with international funding. - Particularly suited to Global South contexts with informal or underdeveloped markets.	- Risk of technocratic rejection if results appear overly complex. - Potential political misuse in criteria selection.

has been increasingly adopted in urban and heritage research as a framework for analyzing public policy, stakeholder systems, and methodological approaches (Hill, Westbrook, 1997; Sýkora, Bouzarovski, 2012).

• **SWOT Analysis** of Principal Economic Evaluation Methodologies for Urban Heritage

• **Implications** for the Multicriteria Sustainability Framework:

1. Empirical anchoring:
- Lessons from Saint Louis, Tunis, and Lviv indicate that a multicriteria framework strengthens public decision-making in Southern cities.
 - Limitations observed in Nice (HPM) and Sant’Erasmus (CVM) highlights the need to integrate non-market values.
2. Recommended structure:
- Economic axis: includes CBA outcomes and revealed values (HPM, TCM).
 - Social axis: derived from survey-based CVM/CE results.
 - Environmental axis: focuses on resilience and ecosystem indicators.
 - Cultural-identity axis: emphasises historical importance weighted through AHP.
3. Presentation and governance:
- GIS-based mapping (as with Pergamon) ensures intuitive interpretation.

DISCUSSION

The cross-sectional analysis of the 60 case studies reveals a significant methodological diversity in the economic valuation of urban heritage, reflecting both the richness of the field and the lack of a unified reference framework. While many approaches draw on established paradigms from public economics or tourism economics, few integrate a truly systemic perspective grounded in strong sustainability.

The comparative matrix (Table V) underscores the limits of conventional methods (CBA, HPM, TCM) which, despite their economic precision, overlook intangible, social, and cultural dimensions. Stated preference tools (CVM, DCE) better address non-market values but remain data-intensive and context-sensitive. In contrast, multicriteria and sustainability-based approaches offer more holistic integration by combining quantitative and qualitative indicators. They align with strong sustainability principles, although they require careful indicator design and participatory calibration. Overall, hybrid and context-adapted tools appear most suited for valuing the complex nature of urban heritage.

The sector diagram (Fig. 3) reveals a pronounced methodological asymmetry in the study corpus. Stated preference techniques dominate, with the Contingent Valuation Method (CVM) alone accounting for just over half of all applications (52%). This hegemony confirms the discipline’s long-standing reliance on willingness-to-pay surveys to cap-

	Strengths	Weaknesses	Opportunities	Threats
All Methods	Solid academic foundations, encompassing well-established methodologies such as Cost-Benefit Analysis (CBA), Contingent Valuation Method (CVM), Hedonic Pricing Method (HPM), and Analytic Hierarchy Process (AHP). Existence of international normative frameworks and methodological guidance issued by institutions like UNESCO, OECD, and ICOMOS. A broad spectrum of empirical applications, ranging from emblematic cases such as Machu Picchu to urban rehabilitation experiences in Cartagena.	Persistent reliance on monetary valuation tools, which often struggle to capture intangible cultural and symbolic values. Tendency to overlook or inadequately reflect local specificities, as observed in heritage sites like the Casbah of Algiers or various North African medinas.	Growing societal demand for sustainability, social inclusion, and participatory heritage governance provides fertile ground for methodological innovation. Promising integration with Geographic Information Systems (GIS), spatial modelling techniques, and circular economy principles to enhance contextual relevance and decision-making accuracy.	Excessive standardisation risks erasing territorial diversity and reducing heritage valuation to technocratic checklists. Risk of heritage appropriation by institutional elites, marginalising local stakeholders and limiting democratic engagement. Ongoing tensions between heritage preservation objectives and increasing land pressure in urban contexts.

TABLE V COMPARATIVE ASSESSMENT OF ECONOMIC VALUATION METHODS IN URBAN HERITAGE CONTEXTS

Method	Economic Accuracy	Integration of Social/Cultural Value	Institutional Accuracy	Environmental Coverage	Required Data	Ease of Communication	References
Cost-Benefit Analysis	High	Low	High	Low	Reliable monetary data	High	Tajani et al. (2016) Tisma et al. (2021)
Revealed Preferences							
Hedonic Pricing Method (HPM)	Medium	Low to medium	Low	Low to medium	Market data	Medium	Rosen (1974) Freeman (2003)
Travel Cost Method (TCM)	Medium	Low to medium	Low	Low to medium	Market data	Medium	Clawson, Knetsch (1966) Freeman (2003)
Stated Preferences							
Contingent Valuation Method (CVM)	Medium	Medium to high	Medium	Medium	Extensive survey-based data	Low to medium	Mitchell, Carson (1989) Bateman et al. (2002)
Discrete Choice Experiments	Medium	Medium to high	Medium	Medium	Extensive survey-based data	Low to medium	Bateman et al. (2002) Hanley et al. (2001)
Multicriteria Analysis	Medium to high	Medium to high	High	High	Mixed (quantitative + qualitative)	Medium to low (depending on simplification)	Pujol et al. (2024)
Sustainability-Based Approach	Medium to high	High	High	High	Mixed (quantitative + qualitative)	Medium to low (depending on simplification)	Dalmas et al. (2014)

ture non-market values, but it also signals a potential vulnerability: over dependence on data intensive instruments that are sensitive to survey design and respondent bias.

Travel Cost Method (TCM) occupies a distant second position (15%), highlighting the weight still given to recreational use values derived from observable behaviour. The modest share held by Hedonic Pricing (3%) and pure Cost-Benefit Analysis (3%) suggests that property-market signals and conventional public-economics tools remain ancillary rather than central in recent heritage research.

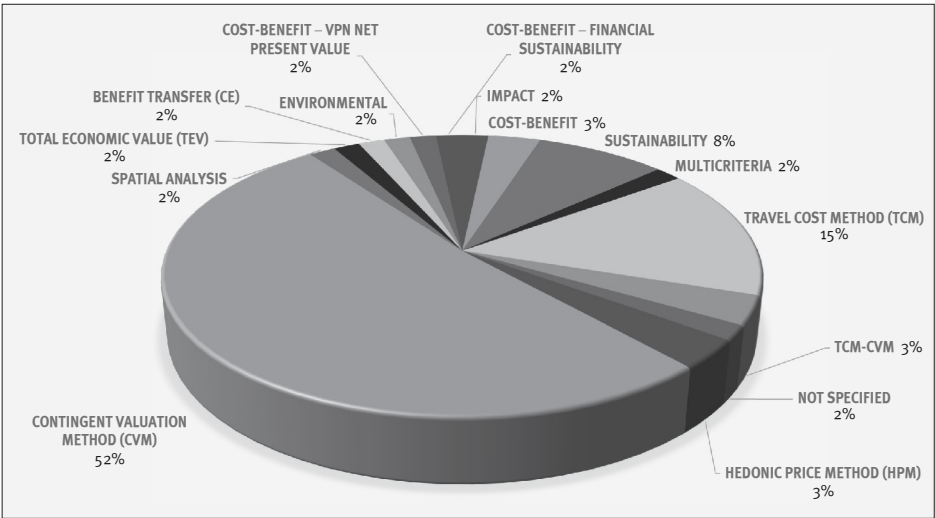
Notably, approaches explicitly framed by strong sustainability (multicriteria models and dedicated sustainability metrics), collectively reach only 10% (8% + 2%), indicating that holistic, cross-pillar evaluations are still emerging rather than mainstream. Equally under-represented are spatial analyses, TEV extensions, and benefit-transfer studies (each 2%), all of which could enhance transferability and contextual nuance.

The corpus is skewed toward monetised, stated-preference techniques, signalling a

need to diversify toward integrative, sustainability-focused approaches.

While most existing studies remain concentrated within Euro-Mediterranean contexts, this research adopts a broader perspective by incorporating case studies from all continents. This global coverage – encompassing

FIG. 3 SECTOR DIAGRAM SHOWING THE DISTRIBUTION OF ECONOMIC VALUATION METHODS WITHIN THE STUDY CORPUS



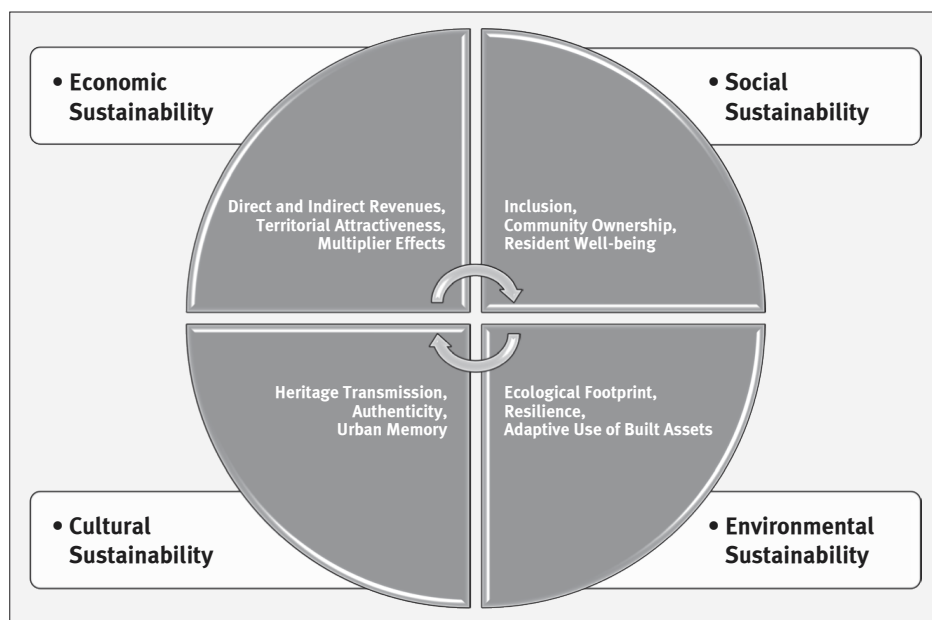


FIG. 4 THE FOUR KEY DIMENSIONS OF STRONG SUSTAINABILITY

Europe, Americas, Africa, Asia, and Oceania – helps overcome the commonly observed geographical bias and enables the assessment of indicator relevance across diverse heritage and socio-spatial contexts.

The critical meta-analysis of economic valuation methods highlights that no single approach (monetary or otherwise is sufficient to account for the complexity of urban heritage). Traditional techniques: cost-benefit analysis, hedonic pricing, contingent valuation, each offer useful insights into specific aspects of heritage value (financial flows, implicit preferences, public attachment). Yet, they tend to isolate one dimension at the expense of a holistic reading. Hence the need to combine them within a more comprehensive framework, capable of capturing the multidimensional nature of historic sites.

The multicriteria approach based on strong sustainability meets this ambition by aligning economic, social, cultural, and environmental criteria with the pillars of sustainable development. It ensures that the preservation of heritage capital is central to valuation processes. Although still emerging in heritage economics (Pujol-Galindo et al., 2024 qualify it as a “new research frontier” in the field), this approach has shown promise in pilot studies (participatory multicriteria assessments conducted in Cartagena, Murcia) and is increasingly endorsed by international institutions.

• **Development of a Multicriteria Grid Based on Strong Sustainability** – Building on the previous findings, a multicriteria analytical grid was developed, structured around the

four key dimensions of strong sustainability (Dalmás et al., 2014; Throsby, 2001; Fig. 4):

- Economic sustainability (direct and indirect revenues, territorial attractiveness, multiplier effects).
- Social sustainability (inclusion, community ownership, resident well-being).
- Cultural sustainability (heritage transmission, authenticity, urban memory).
- Environmental sustainability (ecological footprint, resilience, adaptive use of built assets).

Each axis was operationalized through a combination of qualitative and quantitative indicators, selected from international best practices (World Bank, 2012d; UNESCO, 2011) and adapted to Mediterranean contexts. Indicator weighting was tested using the Analytic Hierarchy Process (AHP), with the aim of applying the framework to complex historic sites.

Data collection relied on a triangulation strategy combining semi-structured interviews with local stakeholders and experts, analysis of policy documents and technical reports, and spatial data processing using GIS. A pilot zone was selected to test the framework, with the intention of ensuring future scalability and transferability to other heritage contexts.

The resulting grid integrates tools rarely combined in earlier studies, and provides a means to assess the economic value of heritage beyond market uses. It captures intangible aspects such as symbolic anchorage, social regeneration potential, and leverage effects on sustainable urban transitions. In this way, the grid reflects the logic of strong sustainability, where each dimension must maintain its critical integrity and cannot be sacrificed for gains in another.

• **Operational Steps and Analytical Tools** – The implementation of the grid followed a structured process encompassing four main phases. The first phase consisted of defining the sustainability dimensions and associated indicators. Drawing from the framework proposed by Vernières et al. (UVSQ, 2012c) for urban heritage, the analysis identified four interdependent dimensions:

- (a) Economic (e.g., income-generating activities, local employment, conservation costs).
- (b) Social (e.g., living conditions, equity, social cohesion, community appropriation).
- (c) Cultural (e.g., authenticity, identity, intangible heritage, transmission of know-how);
- (d) Environmental (e.g., condition of built fabric, urban landscape, ecological impact of interventions).

For each dimension, a set of relevant indicators was selected with a strong emphasis on

the principles of strong sustainability. For instance, built environment indicators included structural stability indices or risk-of-collapse thresholds, while cultural sustainability incorporated an index of cultural vitality (e.g., number of traditional craft practices still active, degree of intergenerational transmission). Social sustainability was assessed through indicators such as community engagement rates or socio-functional diversity indexes. The economic dimension, beyond classic financial indicators, included local viability metrics (e.g., share of local firms involved in rehabilitation, use of local materials and labour).

Each indicator was linked to a clear objective or threshold (maintaining housing vacancy rates below a specific percentage, or ensuring the continued activity of a minimum number of traditional artisans). This threshold logic reflects the non-substitutability premise of strong sustainability, wherein no dimension should fall below its critical minimum.

The second phase focused on data collection and methodological tools. It combined:

- Documentary and historical analysis to understand the site's evolution, legal status, and prior interventions.
- Fieldwork and interviews with residents, users, and experts to gather qualitative insights into social and cultural dynamics.
- Geographic Information Systems (GIS), such as ArcGIS, to spatially map heritage conditions, accessibility, and risk zones.
- Data processing tools, including Excel for score compilation, and where applicable, multicriteria decision-making software (e.g., ELECTRE, PROMETHEE, or simplified scoring matrices).

An essential feature of this phase was the participatory component: local workshops were organized to validate indicator selection and collect qualitative inputs. This approach aimed to foster ownership of the framework by local actors and to ensure its contextual relevance and legitimacy.

• **Multicriteria Evaluation, Scenario Simulation, and Sustainability Diagnostics** – Once the indicators were populated, the third phase consisted of a multicriteria evaluation of the heritage site and a sustainability diagnosis. A synthetic dashboard or radar diagram was constructed, whereby each axis represented one sustainability dimension (economic, social, cultural, environmental), and the value of each indicator was plotted against its target threshold (the “outer radius” of the diagram).

This graphic representation helped identify areas requiring immediate intervention. For

instance, a site could approach critical thresholds in the “built environment” dimension (numerous buildings at risk of collapse), suffer from economic underperformance (low tourist revenues, insufficient funding), but still display strong social and cultural vitality (active community networks, living traditions). Such a profile reveals unbalanced sustainability and signals where priority actions should be focused.

Crucially, strong sustainability requires that all dimensions meet a minimum standard, excellence in one cannot compensate for deficiencies in another. A site with serious physical deterioration, even if economically profitable, would still be considered unsustainable from a heritage standpoint.

For each, projected values indicators were entered into the grid. The results revealed trade-offs: for example, a tourism-focused strategy might enhance the economic score but jeopardize authenticity or community well-being. In such a case, the scenario would be rejected if it fell below critical thresholds in cultural or social dimensions. The multicriteria tool thus enabled a comparative and balanced assessment of strategies, aligned with strong sustainability principles.

The practical implementation of the proposed framework may face several challenges, including limited data availability, institutional constraints, and the costs associated with collecting qualitative information. However, these obstacles do not undermine the relevance of the multicriteria grid; rather, they highlight the need for contextual adaptations and pilot applications. In this regard, the proposed approach should be viewed as a flexible decision-support tool, designed to progressively integrate economic, social, cultural, and environmental dimensions into heritage evaluation processes.

• **Strategic Recommendations, Transferability, and Final Considerations** – Based on the diagnostic results, the multicriteria grid supported the formulation of balanced recommendations. For example, if the analysis revealed structural fragility in the built environment, the priority would be to reinforce or restore key buildings before pursuing tourism development. If cultural vitality appeared threatened (due to declining artisanal activity), measures to support knowledge transmission and local craftsmanship would be proposed. Similarly, if infrastructure expansion projects (such as parking facilities) posed risks to visual integrity or authenticity, the grid allowed for the objectification of trade-offs between accessibility and preservation.

Visual tools (such as sustainability radar diagrams or weighted scoreboards) were used

GLOSSARY OF KEY CONCEPTS

Economic Valuation: The process of estimating the total monetary value of cultural heritage assets, including both market and non-market benefits. It demonstrates how heritage contributes to collective welfare and sustainable development beyond economic profitability.

Multifaceted Benefits (tangible and intangible): Heritage generates tangible benefits such as tourism and employment, and intangible ones such as identity, memory, and social cohesion. These interlinked dimensions sustain cultural vitality and community resilience.

Cost-Benefit Analysis (CBA): A quantitative method comparing the overall benefits and costs of a heritage project to determine its social efficiency. However, traditional CBA often fails to include intangible cultural and social values.

Positive Externalities: Positive impacts produced by heritage that are not reflected in market transactions, such as cultural pride, educational value, or aesthetic enrichment. These social benefits justify public support for heritage conservation.

Total Economic Value (TEV): A comprehensive framework that encompasses direct use, indirect use, and non-use values (existence and bequest). TEV reflects both tangible and intangible motivations for heritage preservation.

Conventional Valuation Methods (CBA, HPM, TCM): Traditional approaches, including Cost-Benefit Analysis (CBA), Hedonic Pricing Method (HPM), and Travel Cost Method (TCM), use market data to infer value. Despite their precision, they overlook social and cultural dimensions.

Stated Preference Methods (CVM, DCE): Survey-based techniques such as Contingent Valuation (CVM) and Discrete Choice Experiments (DCE), which elicit individual's willingness to pay for heritage preservation. They are particularly suited to measuring non-market and intangible values.

to communicate findings to both decision-makers and the general public. These synthetic representations facilitated a holistic understanding of the evaluation, reinforcing the idea that heritage must be approached as a living system, not a static asset. They also emphasized that heritage governance should seek a balance between dimensions, not the maximization of any single indicator.

By adopting this approach, urban heritage sites are no longer reduced to financial burdens or tourist assets, but are understood as complex, dynamic systems where material conservation, local livelihoods, economic viability, and cultural transmission are jointly addressed. This model aligns with the growing consensus among international institutions and heritage scholars advocating for a stronger integration of cultural, social, and environmental values in heritage planning (Getty, 2021; UNESCO, 2011).

More specifically, it echoes the Historic Urban Landscape (HUL) approach promoted by UNESCO, which encourages a shift from isolated conservation interventions to integrated, participatory, and context-sensitive frameworks. The multicriteria tool proposed here offers an operational embodiment of these principles. It helps ensure that future decisions do not sacrifice one dimension of heritage (e.g., authenticity or social cohesion) for gains in another (e.g., economic profit), a constraint explicitly embedded in the logic of strong sustainability.

In conclusion, the multicriteria grid grounded in strong sustainability offers a novel and comprehensive approach to heritage valuation. By bridging environmental economics with holistic value theory, it enables the assessment and governance of urban heritage sites in a manner that is both rigorous and adaptable. This tool equips policymakers with a forward-looking framework that respects cultural non-substitutability while optimizing heritage contributions to current and future urban well-being. In this sense, it provides the conditions for fully embedding heritage conservation within the paradigm of sustainable development.

CONCLUSION

This study offers a critical reassessment of economic valuation methods applied to urban heritage, emphasizing the need to move beyond conventional monetary approaches toward more inclusive and sustainable analytical frameworks. By integrating the principles of strong sustainability into a multicriteria evaluation process, a structured assessment grid was developed to better capture the multifaceted value of heritage in diverse urban contexts.

The results demonstrate the effectiveness of this method in guiding trade-offs between conservation, enhancement, and spatial planning, while maintaining cultural, social, and environmental balances. Far from being a static model, the proposed tool offers a flexible foundation for supporting public decision-making and fostering the co-construction of heritage strategies tailored to local specificities.

By combining analytical robustness with contextual adaptability, this research contributes to the development of renewed methodological standards that can support the evolving trajectories of historic cities toward more equitable, sustainable, and intelligently governed models.

Ultimately, this work seeks to open a space for dialogue between researchers, practitioners, and policymakers by proposing a method that is reproducible, adaptable, and grounded in objective, place-based, and forward-looking criteria. It calls for a broader recognition of heritage as a strategic lever for urban transition and social cohesion.

Finally, further development is needed to test the grid's operational robustness and transferability through its application in urban redevelopment, cultural planning, and heritage management projects. Such extensions could consolidate its role as a decision-support tool and a catalyst for sustainable heritage-led urban transitions.

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SOURCES OF ILLUSTRATIONS AND TABLES

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FIG. 1 THE FIGURE ILLUSTRATES THE COMPLETED BLOCK 23 IN NEW BELGRADE, BUILT IN 1968 AS PART OF THE SOCIALIST-ERA URBAN DEVELOPMENT

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SHAPING OF BELGRADE'S RESIDENTIAL ARCHITECTURE IN THE SOCIALIST PERIOD

BELGRADE SCHOOL OF HOUSING
CENTER FOR HOUSING IMS
HABITOLOGICAL RESEARCH
SOCIALIST PERIOD

The period from the 1970s to the 1980s had a great demand for apartment construction in Belgrade. The study examines how state policies in socialist Yugoslavia shaped architectural design principles, and how these design frameworks influenced everyday social life, with focus on Belgrade area. The research procedure includes the following methods: content analysis of professional and scientific literature in the field of architecture, urbanism and sociology of housing, historical-descriptive analysis of urban policies and housing construction in the period 1970-1980, through a review of available normative acts, publications and documents, interpretation of architectural elements characteristic of the Belgrade School of Housing and theoretical

synthesis of philosophical views on space and home, with critical application in the context of specific architectural practices. The aim is to examine the way in which the architecture of residential space in socialist Yugoslavia, and especially in Belgrade, influenced architectural design principles and how that affected the lifestyle of the population. Through this two-tier relationship - policy shaping architecture and architecture shaping society – the paper reveals housing as an active medium of social engineering. This paper provides a qualitative analysis of historical and architectural sources, with an interpretation of theoretical frameworks of architecture, urbanism and social philosophy.

INTRODUCTION

Architectural design approaches reflect the culture from which they originate, the times, social values and ideas. Changes in architectural design approaches provide insight into corresponding transformation within society.

The Belgrade School of Housing emerged between the 1970s and 1980s in the Socialist Federal Republic of Yugoslavia (SFRY), during a time of intensive construction (Fig. 1, up). The name arose spontaneously and is not official. During those decades, numerous studies were conducted and design principles were established to regulate the creation of high-quality living spaces. The Center for Housing within the Institute for Materials Testing of Serbia, worked on the problem of designing apartments for the domestic market since its establishment. This period is also known for creating the so-called "Belgrade apartment". Designers used standards for designing housing units that were in line with the lifestyle of the local population.

Drawing on numerous studies they conducted, the Belgrade School of Housing developed a conceptual framework intended to raise housing standards. This approach combined principles traditionally applied in the design of individual housing with their implementation in collective housing. Several key characteristics that an apartment should meet at the design stage were defined, such as:

- designing rooms in accordance with the needs and habits of the family, whereby the apartment is divided into a day and night zone,
- dining room as part of extended communication,
- an apartment with two centers, divisible by generations,
- circular communication,
- a technical block as a central element,
- loggia as a constitutive element of the apartment,
- flexibility,
- individualization of multi-family housing,
- coordination of the dimensions of the functional and structural parts of the apartment (Alfirevic, Simonovic Alfirevic, 2013: 45).

The result of the research is a large number of constructed residential buildings which have elements of the Belgrade School of Housing. They were based on the foundations of research conducted at the IMS Center for Housing. The investor of the majority of the apartments was the Yugoslav People's Army, which actively participated in the implementation of the regulations and built apartments for its employees.

Prior research on socialist housing in Yugoslavia has largely focused on architectural typologies and design methods (Baylon, Aleksic, Čanak, Lojanica), habitological research developed at the IMS Center (Mecanov, Petrovic), and contemporary reinterpretations of the Belgrade School of Housing (Kusic, Alfirevic). Additionally, philosophical perspectives on dwelling (Heidegger, Norberg-Schulz, Pallasmaa) and sociological studies of everyday life provided a broader conceptual foundation for understanding housing as a cultural and social phenomenon.

Although these studies provide valuable insight into typological development and theoretical interpretations, they remain limited in scope. Few works examine the relationship between state ideological frameworks, architectural design, and everyday social practices. The interaction between policy directives and spatial design, and their combined influence on social life in socialist Belgrade, remains insufficiently theorized.

The hypothesis of this paper is that housing space in socialist Yugoslavia was not merely a physical structure, but a social instrument shaping family life, gender roles, and collective values. The research problem examines how architectural concepts of the Belgrade School of Housing both reflected and influenced social transformations in late socialist Yugoslavia. The aim is to identify and analyse architectural principles and social intentions

behind housing design in socialist Yugoslavia, and especially in Belgrade.

The present study seeks to bridge these perspectives by examining how architectural form both shapes and reflects social transformation. Furthermore, this paper synthesises philosophical, sociological, and architectural perspectives to explain how the Belgrade School of Housing operated at the intersection of architecture and social change. This paper addresses the identified gap by integrating architectural, sociological, and philosophical perspectives to examine how state policies shaped architectural design, and how architecture, in turn, influenced patterns of social interaction and everyday life. In doing so, the study situates the Belgrade School of Housing within a broader interdisciplinary discourse and clarifies its role as a mediator between ideology and lived experience.

METHODOLOGY

The research applies a qualitative and interpretative approach. The main research question addresses how housing architecture in late socialist Yugoslavia impacted and reflected social transformation. The hypothesis assumes that housing design played a role in shaping collective lifestyles and social values. This is particularly evident within the framework of the Belgrade School of Housing. The methods include:

- content analysis of architectural, sociological, and policy documents from 1970-1980;
- historical-descriptive analysis of housing policy evolution;
- interpretation of philosophical perspectives (Heidegger, Norberg-Schulz) in relation to the social role of architecture;
- comparative analysis of architectural principles proposed by Baylon, Čanak, and Aleksić with contemporary views (Kusić, Alfirević, Mecanov).

The analytical procedure involved categorizing sources by discipline and period, identifying key conceptual frameworks, and synthesizing them to explain the interrelation between architectural design and philosophical perspectives. The research is based on a qualitative analysis of diverse sources relevant to the development of residential architecture in socialist Belgrade.

The primary material includes:

- theoretical and scholarly literature in architecture, sociology, philosophy, and habitology, which provides conceptual frameworks for understanding housing as a spatial, social, and ideological construct;

- housing policies and state guidelines issued during the socialist period, which articulate the institutional objectives that shaped design principles;

- archival materials and period publications, including professional journals, conference proceedings, and reports produced by architectural institutions such as the IMS Centre;

- representative examples of apartment types and housing models, examined through a comparative analysis of their spatial and functional organisation;

- interpretative analyses of lived spatial experience, grounded in phenomenological and philosophical theories of residential space.

Selection criteria were established to ensure relevance for the research focus. Sources were selected on the basis of their compliance with the following criteria: explicitly address socialist-era housing principles; contribute to understanding the ideological, social or functional formation of residential architecture, or form part of the scholarly discourse on the Belgrade School of Housing and habitological research. The material was then categorized into theoretical, policy-related, historical, and architectural-design sources, enabling a structured and targeted analytical process.

The methodological approach is grounded in an interpretative paradigm that understands architecture as a product of ideological and institutional frameworks. At the same time, it considers architecture an active medium that shapes everyday life. This integrated approach directly addresses the research question. It also provides a structured basis for evaluating the hypothesis that residential architecture in socialist Belgrade functioned as a mechanism for social shaping. In particular, it examines how this occurred through the interplay between state policy and design practice.

PHILOSOPHICAL AND EXPERIENTIAL DIMENSIONS OF ARCHITECTURE WITHIN THE INSTITUTIONAL FRAMEWORK OF SOCIALIST HOUSING

Heidegger encouraged considering space as a place for human existence. According to him, the function of architecture is complex, and its essence is not only in shaping the form. In this context, architecture should have content, it should be able to respond to the spiritual needs of a person to the same extent as it responds to functional needs.

In his book "Existence, Space and Architecture" Christian Norberg-Schulz (Norberg-Sulc, 1975), presented a similar idea. He ar-

gued that space should be examined through various concepts interconnected by rational relationships. The space serves to connect man with his biological environment, it manifests his character traits, represents the possibility of interaction with a person's social and cultural nature, it makes us think about the physical world.

Accordingly, it can be said that architecture, in addition to satisfying physical functions, influences the formation of emotions and the mental state of a person. The architectural design of space can have a positive or negative impact. The space in which a person carries out their daily activities can calm, inspire or disturb them. Architecture acts as a stimulus for self-discovery. While it cannot directly influence a person's character or change it in a certain way, it can serve as a guide or reminder of the ideals and values to which a person subscribes.

The idea that architecture shapes a person, and vice versa, was presented by Professor Dr. Mako (Mako, 2015) through an analysis of the adaptation of space to the Christian way of life. He stated that, in the early centuries, Christians were expected to behave in a certain way. They were to inhabit spaces that reflected virtues and a lifestyle aligned with Christianity and the saints they venerated. Further analysis indicated that residential spaces were used to instil these virtues. This practice helped Christians distinguish themselves from pagans.¹

In the modern era, the emphasis is on the construction of buildings, which are designed by determining their primary goals. That is, by considering the requirements in terms of location, purpose and materialization. And then the focus is on shaping the form and interior of the building. The aesthetics of the building are harmonized with its function.

In this way, architecture emerges as a combination of the designer's intuition and professional expression. It serves to foster connections and emotions (Mako, 2005). Such architecture can be created by an architect who combines childhood memories of spaces with knowledge gained from professional practice. In this type of space, the user feels inspired to identify with and engage actively in the environment.

PERSONAL TRAJECTORIES IN SHAPING THE COMPLEXITY OF RESIDENTIAL ARCHITECTURE

Architecture is shaped in accordance with social issues. It does not only represent the aspiration to reaching aesthetic ideals. A well-designed space is one that is in the service of

humans and is designed in synergy with the specific era in which it was built.

In order for residential architecture to be shaped in a functional manner, a complex system should be implemented, one which includes planning, cost-effectiveness and construction technology, ease of maintenance, and continuous adaptation to new criteria in the field of legal regulations. It is also necessary to keep up with the development of residential conditions and current lifestyles. Residential architecture must meet basic human needs, reflected in the desire for shelter, privacy, sociability, and, in the long run, a sense of security as an investment (Petrovic, 2004).

An architect shapes a space under the influence of numerous factors. These include the environment in which they grew up, the environment in which they live as an adult, and the professional principles they have learned (Zumthor, 1999). Therefore, every architect designs differently and architectural design cannot be repeated indefinitely. This is desirable, because through the improvement of architecture, society develops, and the user is also invited to develop.

From a user's point of view, a house in the sense of a residential space is the embodiment of personal identity, an indicator of the individual's personal character and habits. It is also a reflection of the time in which the user lived and an indicator of social changes. Architecture shapes a person in the same way that a person shapes architecture with his biological nature (Norberg-Sulc, 1975). The earliest and most intimate memories are linked to the house. Residential space is to some extent a treasury of memories and a space for free daydreaming (Gaston, 2005).

A person develops their needs in accordance with the environment and their own affinities (Vranicki, 1957). By designing space, architects strive for a balance between needs and the possibility of satisfying them. That is, they aim to fulfil specific residential functions within a given space. These functions can be passive or active, depending on the activities carried out by the individual (De Botton, 2006).

When a person finds himself in a new space, he unconsciously tries to find and recognize the architecture that he is familiar with (Zumthor, 1999). Accordingly, it can be said

¹ A Christian home should aim to remove and completely eliminate extravagant, unnecessary, and insignificant furnishings from both private and public spaces. The focus should be on spiritual development. A common premise underlying these perspectives is that spatial design should respond to users' habits

that architecture, in addition to satisfying physical functions, serves as a stimulus for self-knowledge, influences the formation of emotions and the mental state of a person (Pallasmaa, 1995). However, it cannot directly influence a person's character or change it in a certain way, but it can serve as a guide or reminder of the ideals and values to which a person subscribes.

Without being aware of it, people analyse architecture through all their senses (Pallasmaa, 2005). A residential space can thus be viewed as a kind of a medium (Kusić, 2024).

The daily use of residential space is greatly influenced by the technology used in the household, the relationships between users and the immediate environment. The overall variability of a building largely depends on the available materials and technologies. It must be borne in mind that the construction system is a constant work in progress, which affects the final shape and dimensions of the components, as well as their finishing and assembly techniques. Variability of a building is also affected as well as the fulfilment of environmental requirements such as material recycling and reduced energy consumption and environmental pollution (Krstić, 1997).

STATES' HOUSING POLICIES IN THE SOCIALIST PERIOD

To understand how the socialist period in architectural space shaped everyday life, it is essential to examine the state policies that guided the formation of residential design. These policies shaped the institutional framework that underpinned the phenomenological and experiential constitution of residential space.

While the previous section explored the experiential and phenomenological aspects of residential space, the following discussion examines the policy frameworks that structured residential architecture in socialist Yugoslavia. Together, these two dimensions reveal how ideological intentions were materialised in lived spatial practices.

States' housing policies consist of four basic phases. They are defined based on the analysis of some factors from the past (Petrović, 2004). The first is the restrictive phase in which the aim was to suppress speculation in the housing market. The second is the formative phase, which is reflected in the measures

implemented by the state to support the non-profit sector with the aim of balancing the housing market. The next is the supply phase, where the state played a major role in the supply of apartments, and the fourth phase is the one in which the state played a minimal role in financing housing construction but was present as support for other factors in the housing regime.

The first phase, the restrictive one, is characteristic of the late 19th and early 20th centuries, when a mass migration of the population from rural to urban areas took place. As a form of aid, the state then introduced the so-called "housing allowance" (Petrović, 2004: 16).²

The second phase includes state participation to enable the construction of state-owned housing or housing owned by companies and non-profit organizations. After World War II, housing policy changed as private rent was replaced by public rent. Further changes involved an increasing share of private ownership in the housing stock.

The third phase is characterized by the fact that private ownership became more numerous. In other words, the share of privately-owned units in the overall housing stock expanded considerably.

What these phases demonstrate is that, similar to architects, the socialist states operated within defined constraints and planning regulations that shaped the development of residential architecture. Their actions, therefore, were not entirely autonomous or unrestricted.

European countries that were organized according to the principles of socialist policy, had a large share of the private rental sector in cities in the period before the rise of socialism. That means that they entered the first and second phases of housing policy.

Throughout the socialist period, the dominant stage was the "supply" phase, classified as the third phase in housing policy; a transition to the fourth phase did not occur. The sudden privatisation of apartments led to a rapid shift from state-owned to privately owned housing. In a short period of time, numerous households that were in a challenging financial situation became homeowners. As a consequence, certain financial incentives were abolished. This change had a direct impact on the living patterns of these households.

The vision of the Yugoslav Party was that "Socialism cannot subordinate a person's happiness to some higher goal, because the highest goal of socialism is precisely the personal happiness of the individual." (Kusić, 2024: 47). The goal was to increase wages, strengthen consumption, improve working

and needs, taking into account their religious, physical, emotional, and intellectual dimensions.

² This was a measure to reduce the differences between the new expenses that the family had and the income it had during the adjustment period.

and living conditions, and develop trade activities.³

During the socialist period in Yugoslavia, an apartment was considered a necessity that met the requirements of the modern basic unit of society, i.e. the family. The idea of family life in an apartment was associated with the stability and longevity of the married couple.

The late socialist period, often referred to as the period of industrialization, introduced new models of family housing. In such households, members were equal. There were usually two generations, that is, apartments were meant to accommodate parents and children. There was an ongoing emancipation of women, which resulted in both parents working outside the home. Life in an apartment was promoted as a desirable transitional period from the extended family. It was also advertised as a simpler and faster way to maintain a household and raise a family (Aleksić, 1975). Before this period, multi-generation families mostly lived in one house (Dinić, 2003).

Great attention was paid to organizing the apartment in accordance with the needs of the housewife. The goal was to enable her to comfortably use the residential space.⁴ In addition to family obligations, the apartment needed to accommodate all activities necessary for the household to function properly. It also had to support the housewife in meeting her responsibilities as an employed individual.

Understanding these policy-driven transformations clarifies the reciprocal relationship between ideology, architectural form, and everyday life and provides an essential foundation for the central argument of this paper.

When the philosophical and sociological viewpoints analysed so far are considered together, they support the hypothesis that the development of socialist housing was influenced by multiple, intersecting intellectual currents. This convergence of perspectives reinforces the complexity of factors shaping housing design. Despite their differing emphases, they reveal a coherent and mutually reinforcing influence on the formation of residential space.

RESIDENTIAL ARCHITECTURE FROM THE PERSPECTIVE OF DESIGNERS IN THE PERIOD OF LATE SOCIALISM

Designing residential space is not an exact process. It is not always easy to predict what purposes and needs the space should satisfy for the general public. It is necessary for the architect to follow his instinct, because he has an innate idea of how to move around in

space. During the finalization of the design, the architect's knowledge and experience have an impact (Benjamin, 2011). The space should be designed according to functional activities, according to what will happen in that space, what activities will be performed.

User complaints are important for architects, because users present problems they encounter when using the space. Those are not abstract problems (Baylon, 1976). Such complaints should be considered if they are not the product of acquired bad habits.⁵

Mate Baylon (Baylon, 1972) defined apartment as a space that should follow the development of a person's life and the growth of the family. It should be designed so that its shape changes in accordance with the growth of the number of family members and in accordance with needs that are constantly changing. The apartment should have the ability to transform as the family changes, through all life stages and situations.

In order for an apartment to be planned according to the size of a family, it needs to be designed according to the number of people who will use it. This brings a variety of possibilities for organizing the rooms and the contents of the apartment. On the other hand, when apartments are designed according to the number of rooms, the solutions are not of similar quality.

Baylon also stated that apartments should not be divided into categories imposed by social organizations. An apartment itself cannot be "social" or "workers'". It should be viewed only as a space for people to live and it should be developed in accordance with human needs. However, it is necessary to design it according to social requirements in terms of proper planning, economic viability and ease of maintenance.

The residential space has completely changed since the introduction of modern devices (Kusić, 2024). Such changes are constant and occur in accordance with innovations. According to Heidegger, a person does not free himself from obligations by using modern technology, he changes in accordance with the new technology, adapts to it and takes on

³ This means that socialism cannot give itself the task for which it was created and for which it exists, since socialism is already in the service of the person's personal happiness. One of the most notable outcomes of the program was the significant increase in the number of retail outlets established between 1956 and 1963.

⁴ It was designed with the intention of facilitating the upbringing of children from an early age, which meant easy supervision and monitoring of the development of children.

⁵ It has been noted that users experienced difficulties using the apartment, regardless of whether more

even more obligations (Heidegger, 1977). The imposed lifestyle often led to the omission of a room that served only for rest, relaxation and socializing, undisturbed by electro-mechanical devices and appliances.⁶ Gropius defined such a phenomenon with the following words: "With our enthusiasm for technical inventions, we have infected the whole world, but we have not been able to give spiritual guidance for the wise application of these invented means" (Aleksic, 1975: 17).

Technological progress leads to a loss of individuality. Certain cultural values have been lost in the name of applying the global approach in design. However, the inclusion of local values would open up the possibility of restoring universality in architecture.

The history of architecture is a significant source of information about the principles of construction. Thanks to the architectural design approaches from the past, future architecture continues to evolve with deeper cultural and historical references. New directions do not have to and should not start all over again, but should build on existing ideas. In this way, architectural design approaches are improved, they are more interesting and better than the previous ones. In this regard, architecture is in constant transition, it is reshaped and changed (Radovic, 2001) and new experiences are integrated with the previous ones.

Practitioners have reached the same conclusion as architectural theorists – that space should be designed in accordance with the diverse needs of human life. At the same time, it is essential to ensure that design does not move to the opposite extreme, but rather maintains qualitative functional value. The introduction of modern appliances has had a significant impact on changing everyday habits, posing an additional challenge for designers.

BASIC ELEMENTS OF APARTMENT DESIGN IN THE LATE SOCIALIST PERIOD

By observing family life during the day, designers were able to understand how to divide an apartment space into a day and night

zone. They also noticed that there was a certain grouping of generations (Ristic Trajkovic et al., 2015), whereby the social activities of two generations did not mix. In this regard, the spatial organization allows for a flexible grouping of rooms – either around the sanitary core or the kitchen – depending on whether the intended use prioritizes social interaction or privacy. Thus, the layout of the apartment with two centres was developed.

Circular circulation within an apartment (Fig. 2) is a design solution for situations in which, during everyday use, there is a need to change the direction of movement. The idea was that this element in the organization of the apartment contributed to a better standard of living. This element can be seen in apartments built before World War II (Alfirevic and Simonovic Alfirevic, 2018) and it was retained for apartments built after WW II. Apartments with this element had better connectivity of rooms without unnecessary corridors or separations and better interaction of family members. The circular circulation completely changed the concept of division into day and night zones. This enabled a softer division of the zones in the apartment and a direct connection of the zones was achieved, which allowed for more flexible movement through the space.

Baylon believed that a well-organized apartment, which positively affects the development of the family, cannot have a bed for one family member to sleep in the living room. According to him, the main purpose of the living room is to gather the family and use it for joint activities (Baylon, 1972). If one of the family members uses the living room as a bedroom, that can disrupt that person's peace, personal time and intimacy, and he is in unequal living conditions compared to other members. Furthermore, his study on the organization of the apartment has demonstrated that every dwelling has both upper and lower limits in terms of its spatial area. Within these parameters, the apartment must be designed to meet the needs of the family while remaining within the boundaries of the economic plan, that is ensuring cost-effectiveness (Mecanov, 2008).

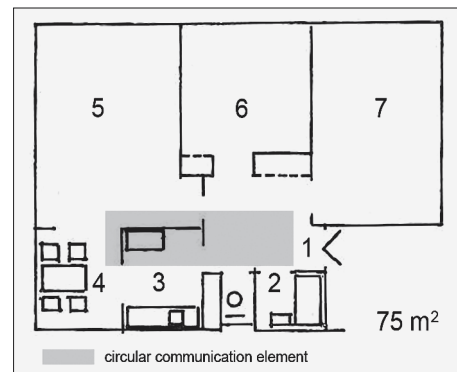


FIG. 2 APARTMENT WITH A CIRCULAR COMMUNICATION ELEMENT:
1 – ENTRANCE, 2 – BATHROOM, 3 – KITCHEN,
4 – DINING ROOM, 5 – LIVING ROOM, 6 – BEDROOM,
7 – BEDROOM

members lived in it than originally planned. Complaints included the inability to install and arrange furniture to meet basic needs, as well as the challenge of organizing daily life according to the requirements of the modern family emerging during the socialist period. A lack of flexibility, necessary to accommodate household changes and development, was also observed.

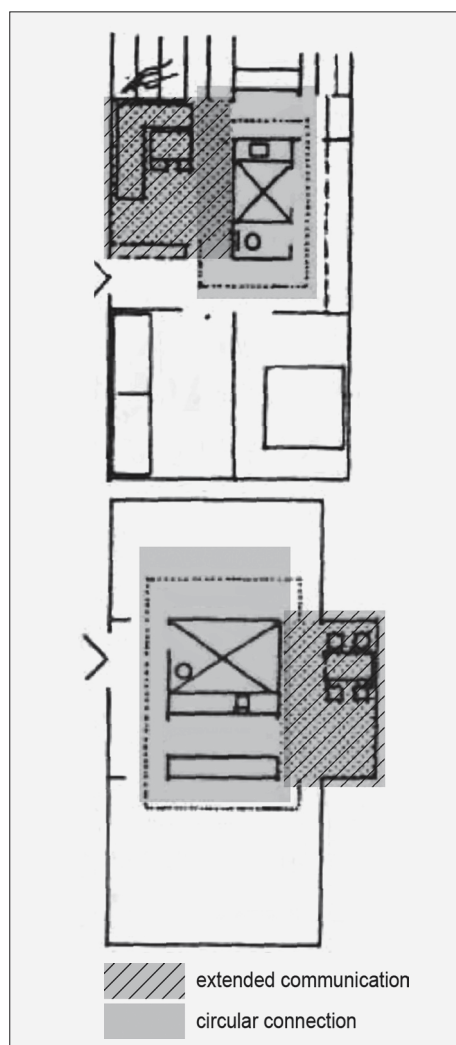
⁶ Although devices are intended to accelerate and simplify certain actions, an emphasis on constant innovation can weaken the connection between people and their residential space. This focus may reduce the meaningful interaction with the environment in which they live.

The element of extended communication was one of the ways in which the problem of planning a bed in the living room was solved, while also providing the option of family gatherings without disturbing the intimacy of a family member who is located in the living room. The concept was first introduced in 1957, when an extended circulation space was placed at the centre of the apartment and used for family gatherings (Baylon, 1975). The focal point of family gathering and



FIG. 3 APARTMENT WITH AN EXTENDED COMMUNICATION, BUILT IN BELGRADE BETWEEN 1957-1958

FIG. 4 APARTMENTS WHERE THE CIRCULAR CONNECTION ELEMENT IS UNITED TO THE KITCHEN VIA EXTENDED COMMUNICATION



socializing was the dining table, which took on a multiple role. It usually served as a place for family meals; however, when combined with the extended circulation space, it could also be used for other activities such as sewing, studying, hobbies, and ironing (Fig. 3).

During the 1960s, the circular connection element was united with kitchen via extended communication (Fig. 4). The extended circular communication served as an additional space for the family's shared activities. It was positioned in front of or next to the kitchen (Baylon, 1977-1979).

In order to advance the social development of the family, the possibility of transforming the living area and gathering family members was considered. Given that the average family had limited financial resources to purchase a housing unit, the transformation occurred through the planning of one bed in the living room. This solution was a bone of contention among architects, who believed that allowing a bed in a room intended for joint activities disrupted the social life of family members and negatively affected any gatherings without the interference of other members. Although the reasons against organizing the apartment in such a way were identified, the instructions for designing apartments still provided for a bed in the living room.

Flexibly designed apartments are those that allow for the adaptation of living space to the growth or decrease in the number of family members and to adaptation due to innovations in standards. Such apartments allow for a change the internal organization of the apartment according to the needs of the household, by moving certain partition walls (Lojanica, 1975).

The example of an apartment in Fig. 5, which changes in accordance with the change in the number of family members, involves converting the loggia into a children's room. The apartment in Fig. 5-d, originally designed for a small family – parents with a baby, after adaptation becomes suitable for accommodating parents and two children. When the first child grows up enough for his own room, and the second child is still in a crib and placed in the parents' room, the loggia becomes a children's room, which is shown in Fig. 5-d2. Then, when both children reach school age, the former loggia becomes a room for two children, which is shown in Fig. 5-d3. And the last change shown in Fig. 5-d4 involves dividing the rooms so that children of different genders have their own rooms at the position of the former loggia and part of the living room.

The flexibility of a housing unit can be achieved during design, construction or during use (Kara-Pešić, 1980). The apartment has a greater utility value if the possibilities of adapting the rooms to the needs of future users are well planned during the design and construction phases.

According to architect Mihailo Čanak, apartments with multiple single rooms are more flexible than apartments with double-bed rooms or apartments with small floor area (Čanak, 1974).

Although the analysed examples of residential architecture from the late socialist period reveal a diversity of spatial concepts and author-specific approaches, they nevertheless share several underlying architectural and social intentions. Rather than forming a single, uniform pattern, these projects demonstrate a heterogeneous set of design strategies shaped by the technological and ideological conditions of their time. Across this diversity, certain recurring objectives can be identified. The use of circular connections, extended communication zones and flexible room arrangements reflects an effort to accommodate changing household structures. These strategies indicate that residential design was not driven solely by functional optimisation, but also by a broader ambition to mediate social behaviour and articulate the values of late socialist society.

This shows that spatial organisation functioned as a mechanism through which architecture participated in shaping everyday life.

The spatial reorganizations often reflected a deliberate effort to preserve areas where immediate family members could gather. They did not promote layouts in which each individual would retreat exclusively to their private room during their free time.

In apartments constructed over the past few years in the Belgrade region, the design of apartments that would enable the former lifestyle has been omitted. Apartments are increasingly designed according to the number of rooms that are required, and not according to the number of people who will use them. In practical terms, this creates problems for apartment users. The lack of pantry, closets, wardrobes and household rooms leads users to narrow the space they have by arranging the necessary storage furniture.

7 The regulation that dealt with the conditions and technical standards for the construction of apartments for the needs of the Yugoslav People's Army defined the functional characteristics and dimensions of the rooms ("Objašnjenje za primenu tehničkog uputstva o izgradnji stanova za potrebe JNA", 1988). In this way, it was ensured that all apartments were designed equally for all members of the Yugoslav People's Army. Also,

Insufficient attention is given to the spatial organization of apartments, particularly to the inclusion of a common area that would enable interaction among all household members. As a result, shared activities within the home are diminished and increasingly transferred to external spaces. Moreover, little emphasis is placed on the efficient organization of interior layouts to optimize available space in relation to the number of occupants – an aspect once advocated by architects such as Baylon and Čanak.

HABITOLOGICAL RESEARCH CONDUCTED AT THE IMS CENTER FOR HOUSING

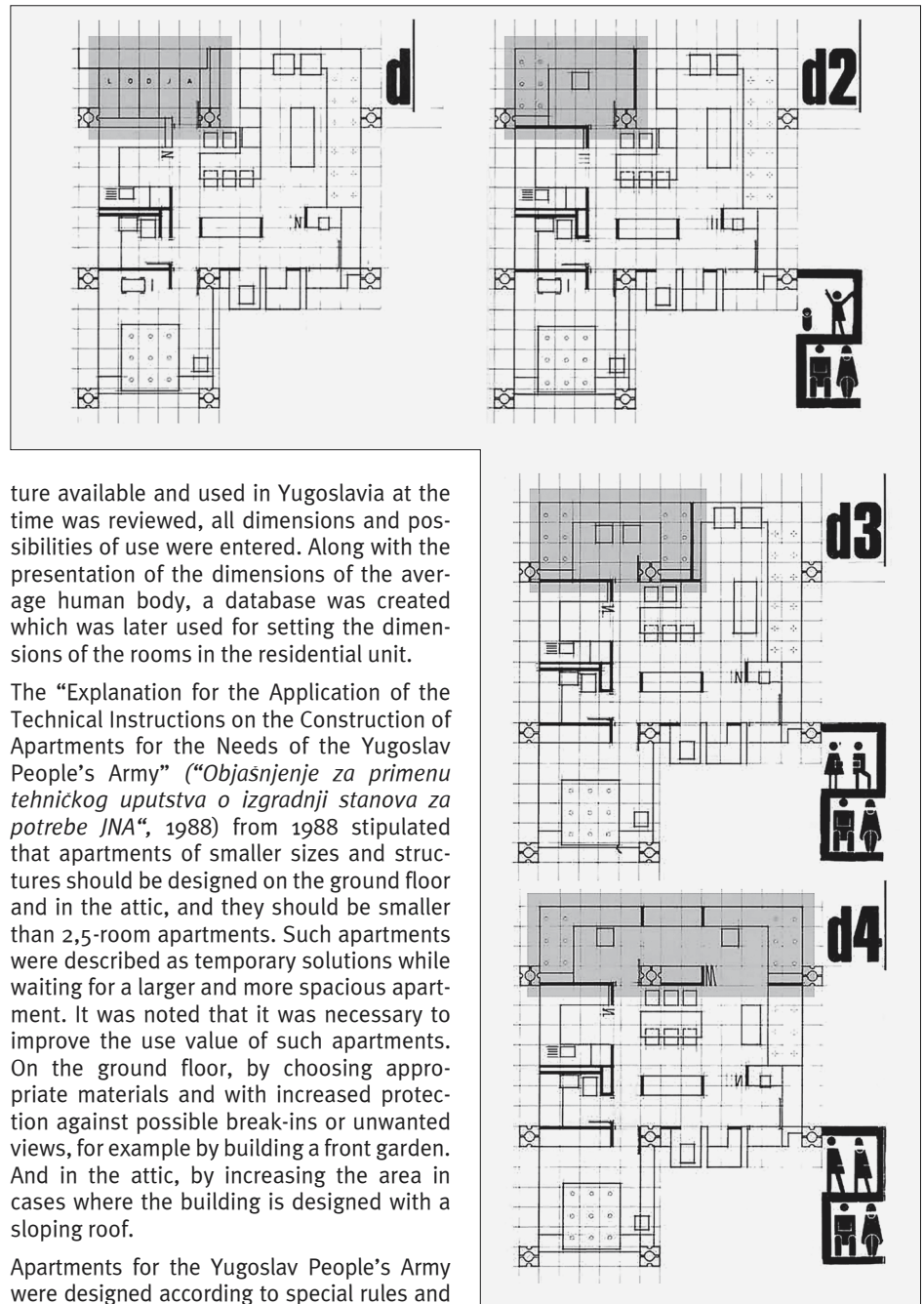
During the 1970s, a need for research in the field of housing construction emerged. The demands for the rapid construction of residential buildings with quality-designed apartments led to numerous notable studies. The studies led to the formation of regulations for the design and construction of residential units according to the needs of domestic users. One of the most important investors in the research was the Yugoslav People's Army, which formed its own regulations for the construction of residential buildings for its own needs (Čanak, 2014). In most cases, military regulations coincide with civilian regulations.

Analyses have been conducted that provide insight into which life functions must be planned in the same space, and can or must be performed simultaneously (Čanak, 2013). As well as which functions can be planned for the same space but cannot be performed simultaneously, or functions that cannot be in the same space at all. For example, sleeping and raising animals can be in the same space but under certain conditions, while it is not advisable to plan sleeping and cooking together (Fig. 6).

The necessary dimensions of residential premises in which the average person feels comfortable were investigated. Various situations in which residential premises are used were studied and the dimensions of the elements and the premises themselves were dimensioned in relation to the dimensions of a person.⁷ Each situation was analysed with and without furniture in the room. In preparation for this exhaustive research, all the furni-

the level of detail of the rules that were developed contributed to faster and more economically acceptable construction.

⁸ It is also noticeable that in the settlements of New Belgrade, where the largest number of apartments for the Yugoslav People's Army were built, the smallest number of hand-operated activities was foreseen compared to the Belgrade average for that time.



ture available and used in Yugoslavia at the time was reviewed, all dimensions and possibilities of use were entered. Along with the presentation of the dimensions of the average human body, a database was created which was later used for setting the dimensions of the rooms in the residential unit.

The "Explanation for the Application of the Technical Instructions on the Construction of Apartments for the Needs of the Yugoslav People's Army" (*"Objasnj enje za primenu tehničkog uputstva o izgradnji stanova za potrebe JNA"*, 1988) from 1988 stipulated that apartments of smaller sizes and structures should be designed on the ground floor and in the attic, and they should be smaller than 2,5-room apartments. Such apartments were described as temporary solutions while waiting for a larger and more spacious apartment. It was noted that it was necessary to improve the use value of such apartments. On the ground floor, by choosing appropriate materials and with increased protection against possible break-ins or unwanted views, for example by building a front garden. And in the attic, by increasing the area in cases where the building is designed with a sloping roof.

Apartments for the Yugoslav People's Army were designed according to special rules and conditions (Kusić, 2024). Compared to other organizations that were investors of housing in Yugoslavia, more precisely for Belgrade, the Yugoslav People's Army financed research and construction of apartments for the highly educated population (Kusić, 2024).⁸

The observed limitations stem from the rapid pace of implementation and the need to address housing issues as they arose. Frequent changes in regulations over several decades prevented the establishment of a consistent set of design principles. Consequently, theo-

FIG. 5 THE EXAMPLE OF AN APARTMENT WHICH CHANGES IN ACCORDANCE WITH THE CHANGE IN THE NUMBER OF FAMILY MEMBERS: d) ORIGINALLY DESIGNED APARTMENT; d2) LOGGIA AS A CHILDREN'S ROOM: LOGGIA IS TRANSFORMED IN A BEDROOM FOR 1 CHILD; d3) LOGGIA AS A ROOM FOR TWO CHILDREN: FORMER LOGGIA AND A SMALLER PART OF THE LIVING ROOM ARE TRANSFORMED INTO A BEDROOM FOR 2 CHILDREN; d4) DIVIDING THE ROOMS AT THE POSITION OF THE FORMER LOGGIA: FORMER LOGGIA AND NOW HALF OF A LIVING ROOM OR IN 2 SINGLE ROOMS, FOR 2 TEENAGERS OF OPPOSITE SEX

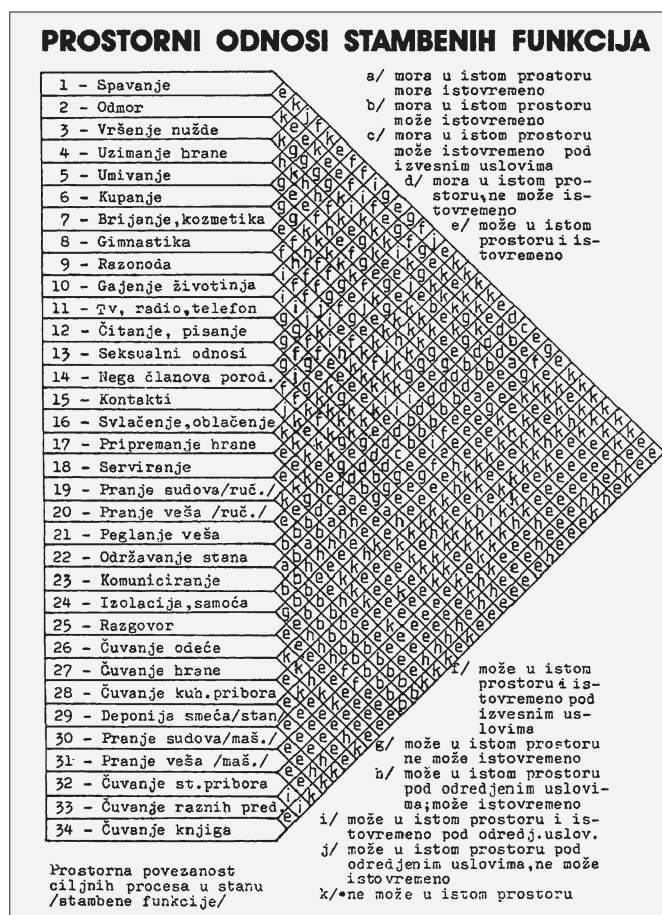


FIG. 6 CONNECTIONS BETWEEN HOUSING FUNCTIONS

Legend: 1 – sleeping, 2 – resting, 3 – use of sanitary facilities, 4 – consumption of food, 5 – performing basic hygiene, 6 – bathing, 7 – shaving and grooming, 8 – home exercise, 9 – recreational activities, 10 – pet keeping, 11 – tv, radio, telephone, 12 – reading, writing, 13 – intimate relations, 14 – family member care, 15 – interactions, 16 – undressing, dressing, 17 – food preparation, 18 – serving, 19 – manual dishwashing, 20 – manual laundry washing, 21 – ironing, 22 – home maintenance, 23 – communication, 24 – social isolation, 25 – conversation, 26 – clothing storage, 27 – food storage, 28 – kitchen utensil storage, 29 – in-apartment waste disposal zone, 30 – mechanical dishwashing, 31 – mechanical laundry washing, 32 – utensil storage, 33 – storage of miscellaneous items, 34 – storage of books; a – must be in the same space, must occur simultaneously, b – must be in the same space, can occur simultaneously, c – must be in the same space, can occur simultaneously under certain conditions, d – must be in the same space, cannot occur simultaneously, e – can occur simultaneously within the same space, f – can occur simultaneously within the same space under certain conditions, g – can occur in the same space but not simultaneously, h – can occur in the same space under specific conditions, can occur simultaneously, i – can occur simultaneously within the same space under specific conditions, j – can occur in the same space under specific conditions, cannot occur simultaneously, k – cannot occur in the same space

retical insights were rarely reflected in practice during the construction process.

While phenomenological theories highlight the existential meaning of space, sociological and habitological studies focus on its regulatory and practical aspects. The present study seeks to bridge these perspectives by examining how architectural form both shapes and reflects social transformation.

The originality of this study lies in connecting philosophical and habitological interpretations of housing with empirical examples from late socialist Yugoslavia. This chapter highlights how architectural space was employed as an instrument of social shaping, mediating between state intentions and everyday cultural practices. In doing so, it reveals how architectural space functioned as a mechanism of social engineering and everyday cultural formation.

CONCLUSION

In each historical period, dominant societal values are reflected in architecture through carefully crafted design elements, shaped by the architect's knowledge, experience and intuitive response to the cultural context. It is up to architects to contribute to creating conditions for the spiritual development of a person when they stay in a designed space.

They have the task of leaving a personal mark and enabling a connection between the space and the user. Through architecture, symptoms of social, economic, scientific, technical and ethnological conditions can be interpreted. A house, or rather a residential space, is a reflection of time, an indicator of the degree of societal development, of acquired and created living habits.

This study has shown that residential space is not only a physical container but also a meaningful reflection of everyday life, shaped by the interplay between user needs, spatial organisation and broader societal values. It was designed according to the needs of the local population, so that they correspond to the needs of the traditional way of life. A space was created for various family gatherings, as well as for carrying out everyday life activities such as sewing, studying or engaging in various hobbies.

This research demonstrated that the Yugoslav socialist apartment was not an ideological cliché but rather a complex research-based product developed to respond to local social needs.

The paper establishes a critical comparison between former and contemporary models of housing, thus confirming its hypothesis both empirically – through case studies and documents – and theoretically – through philosophical and sociological concepts. The main limitation of the research lies in the qualitative nature of the analysed material and the focus on selected case studies.

To gain a better insight into the limitations imposed on residents in housing designed in the previous period, further research could be conducted by surveying residents in one of the recently built-up neighbourhoods in Belgrade. Such data would reveal experiences and opinions about the practicality of living spaces designed for the current period.

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ILLUSTRATION SOURCES

- FIG. 1 BAYLON, 1975: 58
 FIG. 2 BAYLON, 1972: 33
 FIG. 3 BAYLON, 1975: 35
 FIG. 4 BAYLON, 1977-1979: 39
 FIG. 5 LOJANICA, 1975: 22
 FIG. 6 ČANAK, 2014: 169

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Conceptualization: A.R. and N.K.; methodology: A.R. and N.K.; software: A.R.; validation: A.R. and N.K.; formal analysis: A.R.; investigation: A.R. and N.K.; resources: A.R. and N.K.; data curation: A.R. and N.K.; writing – original draft preparation: A.R. and N.K.; writing – review and editing: A.R. and N.K.; visualization: A.R.; supervision: A.R. and N.K.; project administration: A.R.; funding acquisition: A.R. and N.K. Both authors have read and agreed to the published version of the manuscript.

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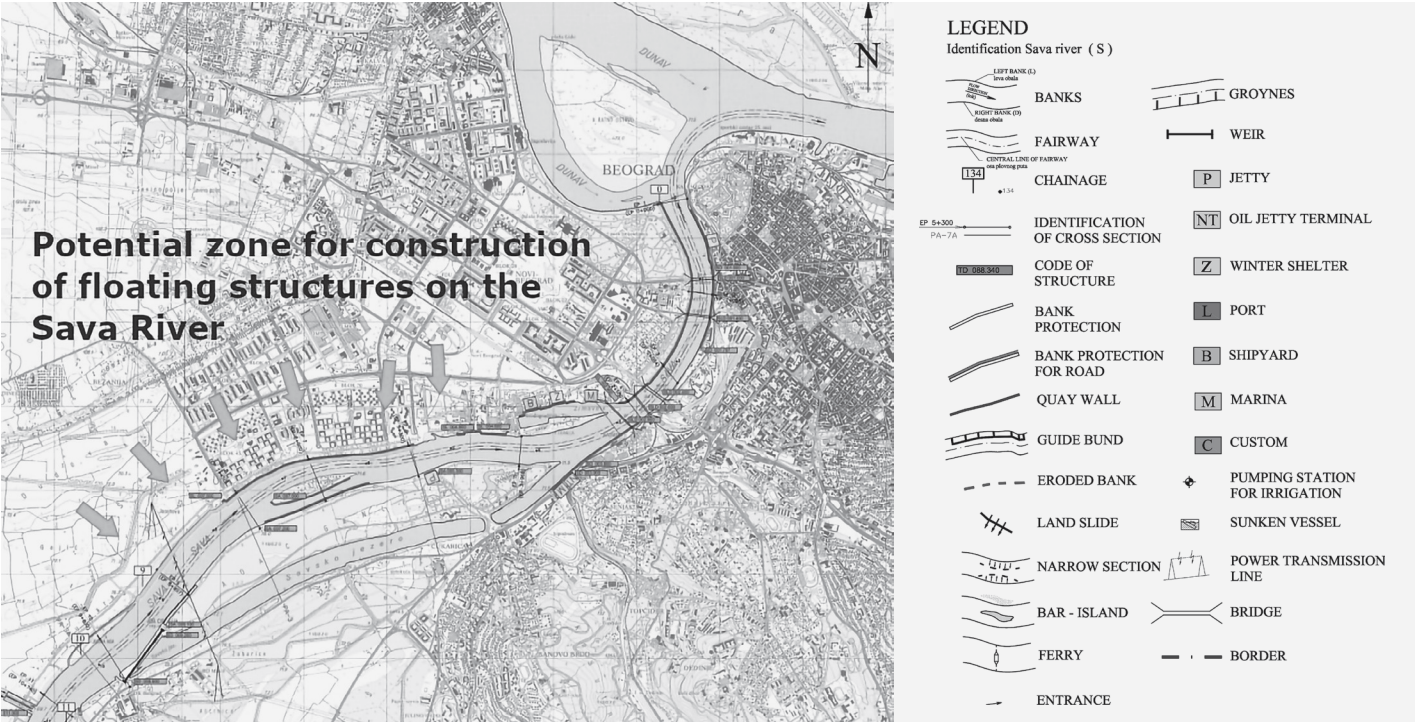


FIG. 1 POTENTIAL ZONES FOR THE IMPLEMENTATION OF MODULAR FLOATING HOUSING ALONG THE SAVA RIVER (KM 9.5-0.0) IN BELGRADE

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FLOATING BUILDINGS AS A RESIDENTIAL SOLUTION IN BELGRADE

BELGRADE SPATIAL PLANNING
CLIMATE RESILIENCE
FLOATING ARCHITECTURE
RIVERFRONT HOUSING
SUSTAINABLE URBAN DEVELOPMENT

This study is intended to provide a preliminary insight into the potential role of floating buildings in redefining residential development in Belgrade. Increasing urban density and land scarcity have encouraged the exploration of alternative housing models, among which floating structures have gained attention due to their adaptability and sustainability. Drawing upon previous research on urban riverfronts and floating typologies, this paper outlines the key environ-

mental, regulatory, and socio-economic dimensions relevant to Belgrade. In addition to theoretical analysis, the research includes a site visit to the IJburg floating housing project in Amsterdam, complemented by a comparative overview of European case studies. The findings are expected to serve as a foundation for continued interdisciplinary research and strategic urban planning along Belgrade's waterfront.

INTRODUCTION

Rapid urbanisation and increasing housing pressures compel cities worldwide to reconsider spatial strategies and explore alternative models that address land scarcity and sustainability. Floating architecture has emerged as a viable, climate-resilient strategy, particularly suited to flood-prone and high-density urban contexts (Olthuis and Keuning, 2010: 22; Kim and Bae, 2020: 3; UN-Habitat, 2019). In Europe, floating typologies have taken diverse forms, reflecting socio-spatial, technical, and governance models. In the Netherlands, Waterbuurt-West – a consolidated neighbourhood within IJburg – and Schoonschip, a self-initiated project, serve as key precedents with varying levels of planning integration (Metabolic, 2019; Schoonschip, 2022). The IBA Waterhouses in Hamburg and Urban Rigger in Copenhagen illustrate modular, mobile typologies supported by institutional frameworks (BIG Architects, 2017; Koekoek, 2010). The amphibious housing cluster in Maasbommel demonstrates a hybrid approach, with homes that float during floods but rest on land in dry periods (Bertram, 2010: 56; Climate-ADAPT, 2020). Together, these five cases reveal the potential of floating settlements to deliver spatial efficiency, energy autonomy, and circular resource systems, while also exposing barriers such as regulatory ambiguity, infrastructural challenges, and maintenance complexity (Lago and Czapiewska, 2020: 97-99;

Jaroszynska and Wolanski, 2019; Kuryłek, 2016).

In Serbia, water-based living remains informal and marginal, often seasonal in nature, and lacking legal or infrastructural support (Vuksanović-Macura, 2017: 118; Planning and Construction Act, 2022). Riverfront development in Belgrade is largely shaped by private investment and excludes inclusive or sustainable strategies (Tilinger and Lalić, 2008: 42). Building on prior research into sustainable housing and waterfront regeneration (Maksimović, 2019; Maksimović and Krstić-Furundžić, 2020), this paper investigates the conditions under which floating housing could be adapted to the Sava riverfront. The aim is not to prescribe a universal model but to identify spatial, institutional, and technical enablers for context-sensitive implementation in Belgrade – an alternative paradigm of urban living in response to ecological and demographic pressures.¹

METHODOLOGICAL FRAMEWORK

This research adopts a qualitative multi-case study design to examine the applicability of floating residential architecture as a sustainable response to Belgrade's urban and hydrological challenges. It employs an analytical-synthetic and comparative method, widely used in architectural and urban planning research for analysing complex typologies and context-specific implementation. Case studies were identified through desk research and targeted digital searches using terms such as "floating housing", "modular floating buildings", "amphibious dwellings", and "water-based urban development". Sources included peer-reviewed articles, architectural monographs, technical documentation, and policy frameworks.

To validate secondary data, a site visit was conducted to Waterbuurt-West in Amsterdam, one of Europe's most integrated floating neighbourhoods (Metabolic, 2019). This enabled in-situ assessment of urban morphology, infrastructure, and typological organisation.

Given the need for climatic, institutional, and infrastructural comparability, the initial search was intentionally limited to European case studies. Non-European cases – although methodologically relevant at the global scale – were excluded due to substantial differences in regulatory regimes, hydromorphological conditions, and governance structures, which would reduce the analytical con-

¹ These studies were presented at the 6th and 7th International Academic Conferences Places and Technologies, held in Pécs and Belgrade respectively.

sistency and limit the transferability of lessons to Belgrade's context.

Five European case studies were selected: Waterbuurt-West, Schoonschip, IBA Waterhouses, Urban Rigger, and Maasbommel. Selection was guided by four criteria:

1. Typological relevance – replicable modular or collective housing rather than experimental or touristic units;
2. Institutional integration – formal inclusion in planning frameworks (BIG Architects, 2017; Schoonschip, 2022);
3. Constructed status – realised and operational beyond the prototype stage;
4. Multi-dimensional urban value – addressing at least two dimensions of environmental sustainability, infrastructural connectivity, or social inclusion (Lago and Czapiewska, 2020: 97-99; Jaroszynska and Wolanski, 2019; Kuryłek, 2016).

Micro-houseboats, individual cabins, and non-residential prototypes were excluded due to their limited urban relevance.

METHODOLOGY

Building on this framework, the study applies a comparative, qualitative multi-case analysis to evaluate the transferability of selected typologies to Belgrade's Sava riverfront. Three complementary methods were combined:

- Document analysis of planning records, architectural documentation, and policy reports (Urban Planning Institute of Belgrade, 2021; Planning and Construction Act, 2022);
- Literature review of peer-reviewed articles, technical studies, and regulatory frameworks;
- Empirical observation during a site visit to Waterbuurt-West, enabling spatial validation under real conditions.

Each case study was evaluated according to five analytical dimensions, selected for their relevance in assessing adaptive housing strategies for urban waterfront contexts:

- 1) Legal and regulatory framework (Planning and Construction Act, 2022);
- 2) Urban integration
- 3) Architectural and technical systems (Olthuis and Keuning, 2010: 22; BIG Architects, 2017);
- 4) Environmental performance (Bertram, 2010: 56; UN-Habitat, 2019; Climate-ADAPT, 2020);
- 5) Socioeconomic dimension (Schoonschip, 2022; Metabolic, 2019).

An evaluation matrix, based on the principles of Qualitative Comparative Analysis (QCA), ensured standardised comparison and the identification of recurring patterns. Cross-

validation with independent sources enhanced reliability and methodological robustness. This structure supports critical analysis of the technological, legislative, spatial, and social conditions required for implementing floating housing in Serbia.

SITE-SPECIFIC CONSIDERATIONS: THE SAVA RIVER AS A TARGET AREA

Building on the comparative evaluation of European case studies, this section narrows the focus to Belgrade and identifies the Sava River as a potential pilot site for floating housing (Fig. 1). It represents the first step in translating general lessons into site-specific conditions. The Sava offers favourable morphology, a moderate hydrological profile, and proximity to strategic urban zones. With an average discharge of about 1,560 m³/s and a width of 200-300 metres, several central segments are non-navigable, making the river technically more suitable than the faster and commercially busier Danube (Plovput, 2018-2022). Underutilised riverbanks – such as Ada Huja, the Lower Sava Amphitheatre, and downstream areas near the Belgrade Waterfront – present promising conditions for developing infrastructurally integrated and ecologically responsive floating neighbourhoods (Tilinger and Lalić, 2008: 42; Vuksanović-Macura, 2017: 118; Maksimović, 2019). However, Serbia's current planning framework creates significant barriers. The General Urban Plan of Belgrade 2041 acknowledges the importance of riverfront development but does not classify floating housing as a legal typology (Urban Planning Institute of Belgrade, 2021). Likewise, the Planning and Construction Act (2022) lacks explicit provisions for modular residential structures on water. Future implementation therefore depends on targeted legal amendments, the creation of new zoning categories, and the adoption of technical standards aligned with sustainable development goals and international best practices (UN-Habitat, 2019; UNEP et al., 2024).

In sum, the Sava River offers technically viable sites for pilot deployment, but regulatory reform is indispensable. These findings form the basis for the following chapter, which examines how European floating housing models can be adapted to Belgrade's institutional and ecological framework.

CASE STUDIES OF FLOATING BUILDINGS IN EUROPE

This chapter presents an analytically structured evaluation of five built examples of floating housing in Europe. Each case was selected based on the methodological crite-

TABLE I CASE STUDIES

Case	Name of Floating Building	Method of Investigation	Location	Year	No. of Units	Avg. Unit Size (m.)	Shared Spaces	Typology
1	“Waterbuurt-West (IJburg)”	Site visit + Docs	Amsterdam, Netherlands	2017	75	100-180	Yes	Modular cluster housing
2	“Schoonschip”	Literature + project documentation	Amsterdam, Netherlands	2019	46	120-160	Yes	Co-housing, community-based
3	“IBA Waterhouses”	Literature + project documentation	Hamburg, Germany	2013	5	140-200	No	Luxury / pilot units
4	“Urban Rigger”	Literature + official website	Copenhagen, Denmark	2016	12	30-40	Limited	Student housing
5	“Maasbommel Amphibious Housing”	Literature + reports	Gelderland, Netherlands	2005	32	100-150	No	Amphibious single-family

TABLE II SYNTHETIC EVALUATION OF REPRESENTATIVE CASE STUDIES OF FLOATING ARCHITECTURE IN EUROPE BASED ON KEY INDICATORS

Case Study	Legal & Reg.	Urban Integration	Arch./Tech. Innovation	Environmental Approach	Socio-Economic Value	Replicability in Belgrade	Author’s Note
“Waterbuurt-West (IJburg)”	☑☑☑	☑☑☑	☑☑	☑☑	☑☑	☑☑☑	Strong precedent; modular typology aligns with Sava riverfront urban conditions.
“Schoonschip”	☑☑	☑☑	☑☑☑	☑☑☑	☑☑	☑	Ecological innovation inspiring, but regulatory model weak
“IBA Waterhouses”	☑☑	☑☑	☑☑☑	☑☑	☑	☑	High-tech pilot; not scalable or socially inclusive
“Urban Rigger”	☑	☑☑	☑☑☑	☑	☑☑	☑	Suitable for student housing; lacks legal and infrastructural integration.
“Maasbommel Amphibious Housing”	☑☑	☑☑	☑☑	☑☑	☑	☑☑	Amphibious model is relevant for flood-prone areas; low-tech and adaptable.

☑ – minimal level of development / indicator present; ☑☑ – moderate development / partially transferable; ☑☑☑ – high development level / directly transferable model

ria previously defined in the research, including typological diversity, integration into urban infrastructure, and relevance for potential adaptation to the riverine context of Belgrade. Rather than relying solely on descriptive narratives, the case studies are analysed through a comparative framework of seven key indicators (see Tables I-II). This analytical-synthetic method enables cross-case evaluation and the identification of shared challenges and opportunities.

- **Waterbuurt-West (Amsterdam, Netherlands)** – Fully integrated into Amsterdam’s zoning plans under the VINEX policy, Waterbuurt-West has legal recognition through cadastral registration and municipal building

regulations. The neighbourhood is connected to standard infrastructure networks (electricity, potable water, sewage, internet, and district heating), demonstrating the feasibility of integration into urban systems (Kurytek, 2016: 155). The modular housing units are built on concrete pontoons, standardised for scalability, though costs remain relatively high (Baker, 2015: 44-46). Environmental strategies include passive solar orientation and stormwater management, though renewable energy use is limited (Bertram, 2010: 56). Socio-economically, the project targeted middle-income groups through a public-private partnership, with limited inclusivity. Its replicability for Belgrade is high due to legal

FIG. 2 VIEW OF WATERBUURT-WEST FLOATING NEIGHBORHOOD, IJBURG, AMSTERDAM



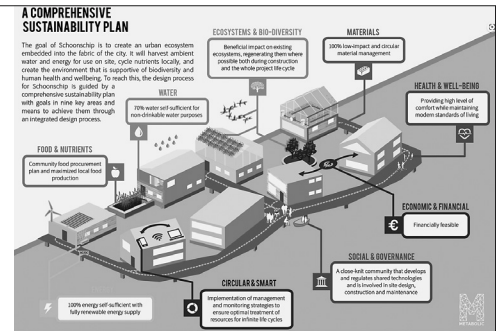


FIG. 3 CONCEPTUAL VISUALIZATION AND SUSTAINABILITY FRAMEWORK OF THE SCHOONSCHIP FLOATING NEIGHBOURHOOD, AMSTERDAM

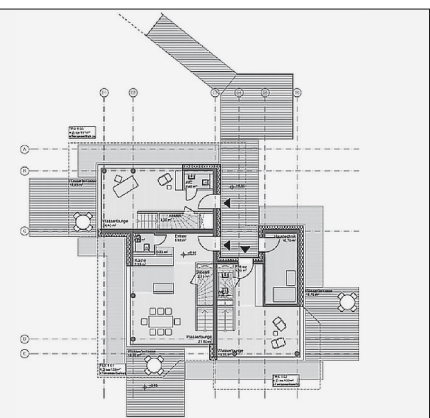
clarity and infrastructural integration but constrained by cost (Fig. 2).

- **Schoonschip (Amsterdam, Netherlands)** – Developed through a cooperative model, Schoonschip demonstrates how bottom-up initiatives can achieve legal integration within Amsterdam's planning framework (Schoonschip, 2022; Metabolic, 2019). It is fully connected to municipal infrastructure and features a collective smart grid enabling energy exchange. Architecturally diverse yet modular in pontoon design, Schoonschip stands out as the most environmentally advanced project, with solar panels, green roofs, and high insulation standards. Its cooperative structure promotes affordability for middle-income groups, though entry costs remain high (CityChangers, 2024). Replication potential exists, but it requires supportive legal and financial frameworks in Belgrade (Fig. 3).
- **IBA Waterhouses (Hamburg, Germany)** – Realised within the Internationale Bauausstellung (IBA) Hamburg 2013, the Waterhouses illustrate how state-backed pilot projects can provide legal and infrastructural legitimacy. Architecturally, they are high-end cus-

tom units with advanced prefabrication, but positioned in the luxury housing segment – limiting inclusivity and scalability. Sustainability features include solar panels and green roofs, though performance monitoring remains fragmented. For Belgrade, the relevance lies more in the policy precedent of using public innovation zones than in replicating the luxury model itself (Fig. 4).

- **Urban Rigger (Copenhagen, Denmark)** – Conceived by BIG Architects, Urban Rigger uses recycled shipping containers on floating concrete platforms. The project operates under temporary harbour leases, with fragmented infrastructure and off-grid systems (Danfoss, n.d.). It targets students through affordable rental models but lacks legal and infrastructural permanence. Replication potential exists in Belgrade for temporary housing in pilot zones, especially for young professionals or students (Fig. 5).
- **Maasbommel Amphibious Housing (Gelderland, Netherlands)** – Developed in collaboration with Dura Vermeer and DeltaSync, this project introduced a legal exception to permit construction in a high flood-risk zone

FIG. 4 IBA WATERHOUSES IN HAMBURG - COMBINATION OF A PHOTOGRAPH OF THE COMPLETED UNITS AND A TECHNICAL FLOOR PLAN. THE PROJECT DEMONSTRATES THE POTENTIAL OF HIGH-QUALITY PREFABRICATION AND INTEGRATION WITH THE URBAN CONTEXT, ALTHOUGH POSITIONED WITHIN THE LUXURY HOUSING SEGMENT.



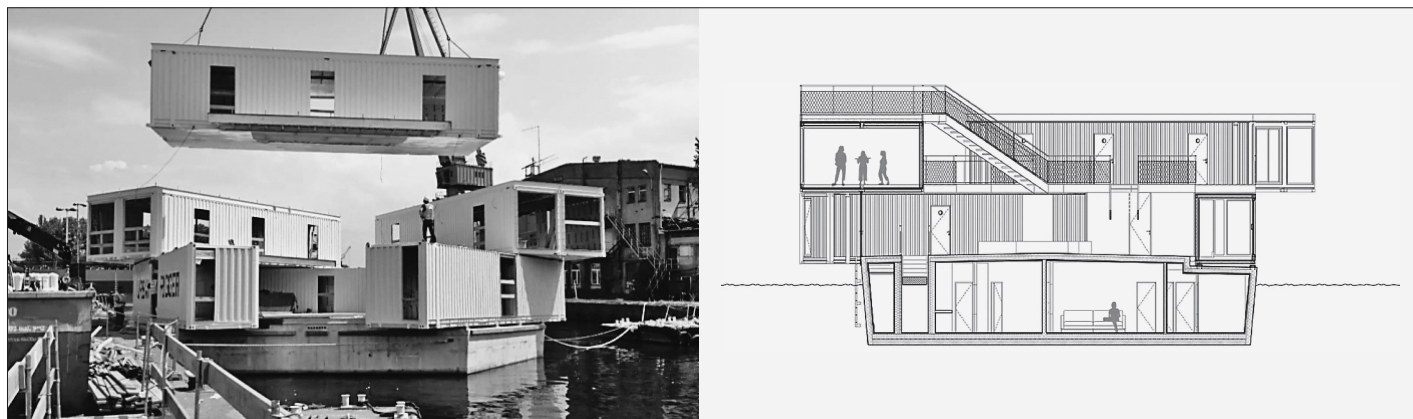


FIG. 5 URBAN RIGGER IN COPENHAGEN – PHOTOGRAPH OF MODULAR CONTAINER UNITS DURING ASSEMBLY AND AN ARCHITECTURAL SECTION DRAWING. THE PROJECT, DESIGNED BY BIG ARCHITECTS, DEMONSTRATES A SCALABLE AND MOBILE TYPOLOGY FOR STUDENT HOUSING ON WATER

(Climate-ADAPT, 2020; UrbanGreenBlueGrids, n.d.). The houses are amphibious – resting on the ground under normal conditions and floating during floods via concrete pontoons. Connected to conventional infrastructure, they adapt through flexible utility connections. While sold at market prices with limited inclusivity, they demonstrate a low-tech, scalable model highly relevant for Serbia's flood-prone riverbanks (Fig. 6).

Table II offers a critical comparison of five European case studies, highlighting strengths, limitations, and lessons most relevant for Belgrade's riverfront adaptation.

The cross-case analysis highlights two transferable lessons: the importance of regulatory adaptability and robust infrastructure integration. Waterbuurt-West offers the strongest urban precedent; Schoonschip illustrates participatory and ecological innovation; Maasbommel demonstrates flood resilience. IBA Waterhouses and Urban Rigger provide insights into policy experimentation and temporary housing, though with limited scalability. No single model fulfils all criteria; instead, a hybrid model – modular, inclusive, and

regulation-ready – offers the greatest potential for Belgrade's Sava riverfront.

ADAPTING FLOATING HOUSING MODELS TO BELGRADE: A COMPARATIVE PERSPECTIVE

This chapter examines how European floating housing models can be adapted to Belgrade's urban, institutional, and ecological conditions. Six analytical dimensions guide the analysis: legal frameworks, infrastructure, architectural typologies, environmental performance, social inclusivity, and replication potential. The aim is to identify enabling conditions and barriers for resilient, inclusive, and sustainable floating housing along the Sava River.

- **Institutional and Planning Framework** – European cases such as Waterbuurt-West, Schoonschip, and the IBA Waterhouses highlight the role of institutional backing. In Belgrade, the General Urban Plan 2041 notes riverfront development but omits floating typologies (Urban Planning Institute of Belgrade, 2021). No clear rules exist for mooring rights, cadastral registration, or insurance (Planning and Construction Act, 2022). To enable legal adoption, Serbia must introduce new classifi-

FIG. 6 AMPHIBIOUS HOUSING IN MAASBOMMEL, NETHERLANDS – RESIDENTIAL UNITS RESTING ON THE GROUND UNDER NORMAL CONDITIONS AND FLOATING DURING FLOODS VIA CONCRETE PONTOONS. THE PROJECT DEMONSTRATES A LOW-TECH YET SCALABLE MODEL FOR CLIMATE ADAPTATION IN FLOOD-PRONE AREAS.



cations, amend planning laws, and set technical standards for buoyancy and flood resilience. Without coordinated governance – e.g., JP Srbijavode, and the ministries of construction and environmental protection – floating housing risks remaining informal.

• **Urban Morphology and Site Conditions** – The Sava’s morphology offers spatial potential, with underutilised zones such as Ada Huja and inner bends downstream of the confluence. However, infrastructure is lacking, and speculative developments such as Belgrade Waterfront dominate riverfront planning (Tilinger and Lalic, 2008: 42; Vuksanovic-Macura, 2017: 118). Lessons from IJburg demonstrate that floating neighbourhoods must be infrastructurally equal to land-based ones to avoid marginalisation.

• **Typological Relevance and Transferability** – This subsection articulates the typological relevance of the selected European floating housing models and evaluates the degree to which their spatial, technical, environmental, and governance features can be meaningfully transferred to the Belgrade riverfront context.

– Waterbuurt-West demonstrates high typological relevance due to its large-scale modular pontoon system, fully integrated infrastructural grid, and clear internal spatial governance hierarchy, all of which align with the morphological and regulatory requirements of Belgrade’s Sava riverfront (Calcagni, 2025).

– Schoonschip exhibits strong transferability because of its cooperative governance model, decentralised utilities, energy-positive design logic, and adaptable modular clusters, although its advanced ecological systems would require significant institutional adaptation within the Serbian regulatory context (BIG Architects, 2016).

– The IBA Waterhouses provide a valuable typological precedent through prefabricated hybrid structures supported by municipal innovation frameworks and embedded within long-term urban regeneration, demonstrating how state-enabled experimentation can legitimise new urban residential formats – an approach directly relevant for Belgrade.

– Urban Rigger illustrates a compact, replicable typology based on modular, stackable units suited to student and young-professional housing, suggesting high transferability for Belgrade’s educational and innovation districts along the river (BIG Architects, 2016).

– The Maasbommel amphibious typology offers direct relevance for flood-exposed segments of the Sava basin, combining land-based stability with flood-responsive buoyancy, and therefore represents a particularly strong candidate for adaptive residential development in Belgrade (Climate-ADAPT, 2020).

TABLE III COMPARATIVE ENVIRONMENTAL LESSONS		
Case Study	Ecological Measures	Lesson for Belgrade
Waterbuurt-West	Limited renewables, passive design	Upgrade sustainability benchmarks
Schoonschip	Floating wetlands, smart grid	Combine ecology and energy strategies
IBA Waterhouses	Buffer zones, rainwater harvesting	Use state-backed pilots for monitoring
Urban Rigger	Off-grid solar, recycled containers	Test temporary pilot housing solutions
Maasbommel	Amphibious lots, flood adaptation	Apply to flood-prone peripheries

• **Environmental and Public Value Considerations** – Sustainability must extend beyond energy to encompass ecosystem health. While projects such as Schoonschip integrate floating wetlands and smart grids (Metabolic, 2019), Belgrade lacks ecological zoning and environmental monitoring. Riverbanks are largely privatised, limiting public access (Vujosevic and Petric, 2015). The UN-Water SDG 6.6.1 report underscores the need for biodiversity-sensitive indicators, yet Belgrade currently lacks baseline ecological data (UNEP and UN-Water, 2024). Table III provides a comparative overview of key environmental and infrastructural strategies applied across the selected European floating housing projects. It synthesises measures such as floating wetlands, decentralised energy systems, passive orientation, and adaptive buoyancy solutions, highlighting which ecological interventions are most relevant for Belgrade’s hydromorphological conditions. By structuring these strategies side by side, the table enhances the analytical coherence of the chapter and clarifies which models offer the highest transferability to the Sava River context.

STRATEGIC DIRECTIONS FOR BELGRADE

The following strategic directions synthesise the institutional, spatial, infrastructural, and ecological priorities required to integrate floating and amphibious housing into Belgrade’s planning framework.

1. Introduce new zoning categories for floating and amphibious housing (Planning and Construction Act, 2022).
2. Designate specific implementation zones (e.g., Ada Huja, inner Sava bends) with integrated utility provisions.
3. Include floating typologies in strategic documents such as the General Urban Plan 2041.
4. Treat water as a public good – develop participatory planning methods and prevent riverbank privatisation (UNEP, 2024; Vuksanovic-Macura, 2017).
5. Pilot modular housing typologies (e.g., Urban Rigger) to test legal regulations, infrastructure performance, and community acceptance.

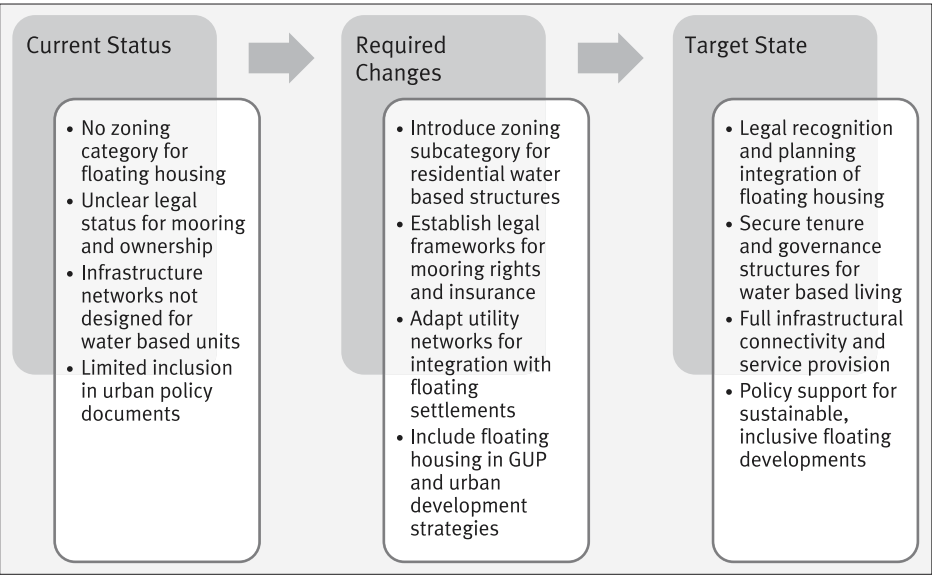


FIG. 7 INSTITUTIONAL PATHWAYS TOWARD LEGALIZING FLOATING HOUSING IN BELGRADE

The diagram on Fig. 7 synthesizes the institutional and regulatory transformations necessary to enable the full integration of floating housing into Belgrade’s urban framework. Moving from the current absence of zoning categories and legal ambiguity, to a state of legal recognition, infrastructural parity, and policy inclusion, requires a multi-level and cross-sectoral effort.

European precedents confirm that Belgrade cannot directly replicate but can selectively adapt floating housing models. Priority lies in legal innovation, intersectoral coordination, and ecosystem-based design. A hybrid ap-

proach – modular, inclusive, and regulation-ready – offers the greatest potential for integrating floating housing into Belgrade’s Sava riverfront.

CONTEXTUAL ADAPTATION:
TOWARD FLOATING LIVING IN BELGRADE

Insights from European case studies demonstrate not only the technical feasibility of floating housing but also the institutional, ecological, and social mechanisms that support its implementation. For Belgrade, the value of these precedents lies less in direct replication than in their adaptive potential. This chapter therefore examines how lessons from Waterbuurt-West, Schoonschip, the IBA Waterhouses, Urban Rigger, and Maasbommel can be translated into Belgrade’s spatial and institutional context. The analysis is structured around four interrelated themes: institutional frameworks, environmental and civic dimensions, spatial integration zones, and strategic planning prerequisites. By embedding the analytical-synthetic framework developed in this research, the chapter moves from comparative evaluation to local application – assessing how floating housing could be planned, regulated, and socially embedded along the Sava River. The aim is to identify enabling conditions, expose regulatory gaps, and outline pathways through which floating housing might evolve from conceptual innovation into a legitimate urban typology in Belgrade.

Institutional Roadmap for Integration – Currently, Belgrade has no legal category for floating residences, and regulatory gaps exist across construction codes, utilities, insurance, and property rights (UN-Habitat, 2020). To move from institutional ambiguity toward systemic inclusion, a phased roadmap is required. Table IV outlines a phased institutional roadmap that illustrates how Belgrade could progress from the current legal vacuum toward full integration of floating housing. It identifies key governance milestones – from regulatory recognition and legal reform to infrastructure alignment and pilot implementation – thereby clarifying the administrative steps necessary to support long-term adoption.

This roadmap reflects a transition from fragmented governance toward a systemic urban policy framework – anchored in cross-sectoral collaboration, legal precision, and ecological responsibility – thereby enabling floating housing to evolve from conceptual innovation to legitimate urban typology.

Environmental and Civic Dimensions – Environmental responsibility is essential to the long-term viability of floating housing. In Bel-

TABLE IV INSTITUTIONAL ROADMAP FOR FLOATING HOUSING IN BELGRADE

Phase	Key Features	Lesson for Belgrade
a) Legal Vacuum	No codes, zoning, or legal definitions for water-based housing	Blocks planning and investment
b) Recognition	Expert debate and awareness raising	Initiate academic and civic dialogue
c) Legal Reform	Amend GUP, introduce subcategories, clarify cadastre	Establish legal certainty for housing on water
d) Infrastructure Alignment	Integration with utilities; compliance with EIA & SDG 6.6.1	Align with EU and UN environmental standards
e) Pilot Deployment	Modular units tested in controlled zones (Ada Huja, Blokovi)	Evaluate technical feasibility and public response
f) Urban Integration	Floating housing embedded in long-term plans; rivers as commons	Ensure inclusivity and ecological protection

TABLE V ENVIRONMENTAL AND CIVIC LESSONS FROM EUROPEAN PRECEDENTS

Case Study	Ecological Measures	Civic/Policy Implications
Waterbuurt-West	Passive orientation; stormwater management	Legal clarity; infrastructural integration
Schoonschip	Smart grid, floating wetlands	Cooperative model; public access
IBA Waterhouses	Green roofs, rainwater harvesting	State-backed pilot; policy integration
Urban Rigger	Off-grid solar, recycled containers	Temporary/affordable student housing
Maasbommel	Amphibious resilience, flood response	Legal adaptation in risk zones

grade, such developments must address not only flood resilience and infrastructural integration but also the ecological and civic dimensions of water management. Reclaiming the river as a shared civic and ecological commons is crucial for ensuring spatial equity and sustainability. European precedents demonstrate that technologies such as floating wetlands, decentralised wastewater treatment, and adaptive energy systems are effective only when embedded within governance frameworks that guarantee public access, transparency, and long-term monitoring. In line with SDG Indicator 6.6.1 (Change in the extent of water-related ecosystems over time), floating housing should be preceded by environmental impact assessments (EIA) and monitored through biodiversity performance indicators (UNEP, 2024). Unlike Amsterdam or Hamburg, Belgrade lacks baseline ecological data – including macrophyte density, benthic invertebrates, and fish diversity – making it difficult to evaluate long-term consequences. Establishing systematic biodiversity monitoring and participatory environmental councils would enhance transparency, prevent riverbank privatisation, and secure rivers as public goods. Ecological safeguards and civic governance must therefore be treated not as optional add-ons but as structural prerequisites for sustainable floating housing. While the inclusion of a separate ecological indicator in the case study evaluation exceeds the scope of this research, the analytical-synthetic framework nonetheless integrates environmental concerns across institutional feasibility, socio-political inclusion, and infrastructural adaptability. Table V synthesises ecological and civic governance lessons from the five European case studies. By comparing environmental measures with their corresponding policy implications, the table identifies which governance mechanisms – such as biodiversity monitoring, public access safeguards, and state-enabled pilot zones – are most transferable to Belgrade’s riverfront development.

Spatial Potential and Integration Zones – Three priority zones along the Sava River emerge as suitable contexts for controlled pilot deployment of floating housing. The New Belgrade Blocks (70-72), with their wide river section and proximity to existing utilities, are well suited for student or affordable housing pilots. Ada Huja, an underused industrial zone prone to flooding, offers potential for mixed-use floating clusters with ecological buffer zones. Ćukarica Bay, with its semi-enclosed morphology and low current, provides favourable conditions for a recreational and residential floating settlement.

Prerequisite	Description	Relevance for Belgrade
• GUP Inclusion	• Formal recognition of floating/amphibious	• Establishes planning legitimacy
• Zoning Reform	• Legal status for residential water-based units within cadastral system	• Creates regulatory certainty
• Institutional Collaboration	• Coordination across planning, water, and environmental agencies	• Enables coherent governance
• Participatory Planning	• Mechanisms for civic benefit and transparent regulation	• Secures social inclusivity

Together, these locations illustrate how diverse hydromorphological and infrastructural contexts can support differentiated models of floating housing in Belgrade (Tilinger and Lalic, 2008: 42; Vuksanovic-Macura, 2017: 118; Urban Planning Institute of Belgrade, 2021).

Strategic Planning Prerequisites – For floating housing to move from concept to viable urban policy, four prerequisites must be addressed through planning and governance reforms (Fig. 8).

Reframing the River-City Interface – By treating the river not merely as a scenic backdrop but as a spatial and ecological platform, Belgrade has the potential to redefine its urban-river interface. Floating housing, if institutionally supported and ecologically embedded, could serve as a model for adaptive urbanism in Southeast Europe – bridging the divide between housing innovation, environmental resilience, and democratic governance.

CONCLUSIONS

This research has demonstrated that floating housing is more than an architectural experiment: it is a climate-adaptive, socially inclusive, and institutionally demanding typology with the potential to reshape Belgrade’s river-city interface. The study introduces an original analytical-synthetic framework that applies context-specific indicators to assess the legal, spatial, environmental, infrastructural, and socio-economic feasibility of floating settlements. By combining comparative case study analysis with field validation in Waterbuurt-West (IJburg, Amsterdam), it expands the methodological toolbox for urban

FIG. 8 STRATEGIC PLANNING PREREQUISITES FOR BELGRADE

studies and architectural practice in post-socialist contexts.

Five European cases – Waterbuurt-West, Schoonschip, IBA Waterhouses, Urban Rigger, and Maasbommel – were evaluated not for direct replication but for their adaptive potential. The analysis confirms that modular and amphibious typologies offer pragmatic pathways for Belgrade, while cooperative models require legal and financial innovation. Key transferable lessons include the need for regulatory clarity, infrastructural parity with land-based housing, and the embedding of ecological safeguards.

The study reframes Belgrade's rivers not as residual territories but as vital commons capable of supporting resilience and public value. Floating housing thus becomes a test of democratic governance of urban waterscapes. Without legal reform and ecological integration, such projects risk reproducing privatisation and environmental degradation. With them, however, Belgrade could pioneer a new paradigm of inclusive and adaptive water-based urbanism in Southeast Europe.

Methodologically, the article advances research by integrating spatial mapping, hydrological assessment, and typological comparison into a multi-indicator framework, enabling side-by-side evaluation of projects and providing a transferable model for other river cities. Although it relies primarily on secondary data and a single field observation, it establishes a basis for future research through stakeholder interviews, participatory co-design, and scenario-based simulations.

For governance, the findings underscore the urgency of zoning reform, cadastral recognition of floating typologies, and intersectoral coordination. For design, they highlight modular prefabrication, phased pilot projects, and ecosystem-based strategies – such as floating wetlands and decentralised wastewater systems – that can enhance resilience and generate public benefit.

Ultimately, floating housing in Belgrade is not only a response to climate pressures and spatial scarcity but also an opportunity to redefine the city-river relationship. By embedding legal innovation, infrastructural integration, and participatory governance, Belgrade can establish itself as a regional reference point for adaptive river-based living aligned with global sustainability goals.

[Translated by Branka Kosuh]

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- FIG. 1 Adapted by the author based on: Urban Planning Institute of Belgrade (2021), General Urban Plan 2041; and Ministry of Construction, Transport and Infrastructure (2021), Master Plan of Inland Waterway Transport – Serbia
- FIG. 2 Author's field visit and photographic documentation during site survey of floating buildings in Ijburg

FIG. 3 ArchDaily (2021) "Amsterdam's Floating Neighbourhood Schoonschip Offers a New Perspective on Circularity and Resiliency." Available at: <https://www.archdaily.com/964050/amsterdams-floating-neighbourhood-schoonschip-offers-a-new-perspective-on-circularity-and-resiliency>

FIG. 4 Schenk Fleischhaker Architekten, "IBA Waterhouses, Hamburg" (<https://www.schenk-fleischhaker.de/projects/iba-waterhouses/>)

FIG. 5 BIG Architects, "Urban Rigger Project" (<https://big.dk/projects/urban-rigger-3021>)

FIG. 6 UrbanGreenBlueGrids – "Amphibious Homes, Maasbommel, The Netherlands" (<https://urbangreenbluegrids.com/projects/amphibious-homes-maasbommel-the-netherlands/>)

FIG. 7 Author's elaboration based on Urban Planning Institute of Belgrade (2021), Planning and Construction Act (2022), UN-Habitat (2019), UNEP et al. (2024), IBA Hamburg (2013), Climate-ADAPT (2020)

FIG. 8 Author's synthesis based on Urban Planning Institute of Belgrade (2021), Planning and Construction Act (2022), VukSANOVIC-MACURA (2017), UN-Habitat (2019), UNEP (2024)

TABLE I Author's synthesis based on Baker (2015), Bertram (2010), Kurytek (2016), BIG Architects (2017), Danfoss (n.d.), Metabolic (2019), Schoonschip (2022), IBA Hamburg (2013), Climate-ADAPT (2020), UrbanGreenBlueGrids (n.d.).

TABLE II Author's synthesis based on project documentation, academic publications, and official websites (e.g., Urban Rigger, Maasbommel, Schoonschip, Waterbuurt-West, IBA Hamburg). Full references are provided in the Bibliography section.

TABLE III Author's synthesis based on Baker (2015), Kurytek (2016), Metabolic (2019), Schoonschip (2022), IBA Hamburg (2013), BIG Architects (2017), Danfoss (n.d.), Climate-ADAPT (2020), UrbanGreenBlueGrids (n.d.).

TABLE IV Author's synthesis based on Urban Planning Institute of Belgrade (2021), City of Belgrade (2021), Planning and Construction Act (2022), UN-Habitat (2019), UNEP (2024).

TABLE V Author's synthesis based on Metabolic (2019), Schoonschip (2022), IBA Hamburg (2013), Climate-ADAPT (2020), UNEP and UN-Water (2024), Kurytek (2016).

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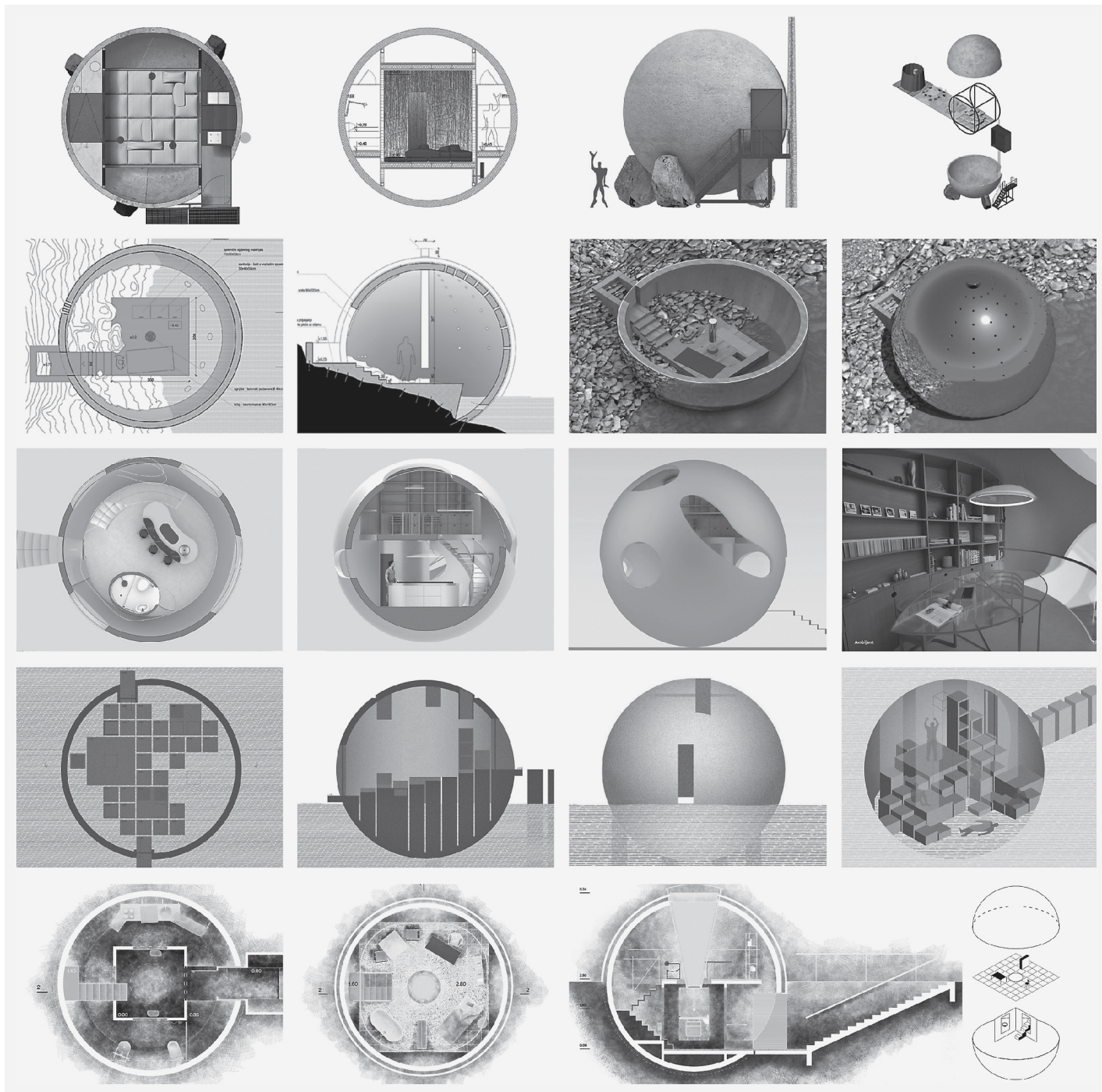


FIG. 1 STUDENT PROJECTS ON THE THEME OF A SPHERE WITH SET DIMENSIONS,
 INTERIOR WORKSHOP, ACADEMIC 2020/2021.
 FROM TOP TO BOTTOM, THE STUDENTS JELKA BOGDANIC, FILIP HERLJEVIC,
 VAL KALINIC, LOVRO MARKUS, MILJENKO LOVRE TRUTINA;
 SUPERVISOR: PH.D. DINA VULIN ILEKOVIC, PROFESSOR



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SCIENTIFIC SUBJECT REVIEW

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FROM BUBBLE TO HABITABLE SPHERE THE POTENTIAL OF SPHERE IN INDIVIDUAL HOUSING

BUBBLE HOUSE
HABITABLE SPHERE
INDIVIDUAL HOUSING
NEW DOMESTICITY

The objective of this research is to examine the potential of the sphere in the context of architecture for individual housing. The point of departure is the idea of the bubble and the identification of the connotations inherent to it since antiquity that have inspired architects to employ spheres that challenge settled architectural paradigms. The development and use of the sphere are presented through a selection of the most important examples – from the first known utopian vision designed by Antoine Laurent Thomas Vaudoyer in 1783 to the constructed and actually used facilities designed for individual dwellings in the 20th century. The interior design strategies that can address the challenges posed by curved envelope and optimize the use of space in spherical individual dwellings have been further explored in a practical assignment given to students enrolled in the Interior Workshop

in the Graduate Programme of Architecture and Urban Planning at the Faculty of Architecture in Zagreb in the academic year 2020/2021. In addition to these architectural problems of formal nature, the intention of this design-driven experiment was to examine the affinity of the younger generation towards moving away from traditional models of layouts for individual housing, with the goal of possibly creating more humanized spaces that support the idea of a *new domesticity*: nomadic lifestyles, the integration of work into the domestic sphere, new family models (e.g., single-occupant) or the increasing need for privacy. In the architecture of individual housing, the sphere is in general an uncommon phenomenon. And yet there is a perceptible continuity of innovative architectural forays into the search for the most effective application of this elementary geometrical form.

INTRODUCTION

The sphere is applicable in design and in architecture, from the helmet that encases the head and the chair¹ that is a capsule partly surrounding a space for the body to the residential scale of a dwelling place (Fig. 2) and sphere on a town planning scale, of the kind conceived by Buckminster Fuller.² A building with spherical geometry is inherently evocative, provocative and appealing, particularly in comparison with orthogonal structures. It will also provide, depending on the properties of the membrane that defines it, a distinctive spatial experience. The sphere is autonomous, without any dialogue with the context. It can have at one and the same time the character of timelessness and overtones of futurism. The universality of the form has its own symbolic and metaphorical charge, potentially intelligible to heterogeneous classes of people. The very form, if it is integral, suggests the possibility of mobility, of hovering, rolling or floating. The full experience of the form will sometimes involve not only the sense of sight but other senses and feelings.

A geometrically regular spherical or hemispherical body has over the course of history tended to symbolise completeness, perfection, the heavenly vault. True, symbolism in architecture does not stand still, developing in time in tune with changes in the cultural and social contexts. And yet a work of architecture can still retain the fundamental sig-

nificance and relevance of its symbolism over the long term, if it stems from the most elementary sensations of perception.³

Based on this context, the research seeks to address the following questions: What architectural, structural, and socio-cultural factors make the sphere suitable for individual housing? How can design strategies respond to challenges associated with spherical geometry, such as space optimization and construction methods? And finally, can the sphere contribute to a redefinition of domesticity, creating symbolic spaces that reflect contemporary living patterns?

Constructing according to the bubble principle is building with air.⁴ Air can be identified with flight in physical and figurative senses. According to Gaston Bachelard, the element of air contains the psychology of the imagination of movement (Bachelard, 2011: 7), i.e., serves as driver of the dynamic process of the imagination.

In a creative partnership with Shoji Sadao, Buckminster Fuller devised the utopian architectural vision of Cloud Nine⁵, 1960, a levitating sphere 1.6 km in diameter meant for the accommodation of thousands of inhabitants forming the aerial city (Fig. 2). The idea draws on the hypothesis that the raising of the inside temperature by a single degree would enable the sphere to levitate like a balloon. In opposition to floating spheres was the dystopian vision of subterranean spheres beneath Manhattan thought up in 1969 by Oscar Newman and illustrated by Jean Laggarigue (Fig. 2). Underground spheres with a volume of about 5 cubic kilometres were conceived as huge nuclear attack shelters; the author's paradoxical idea was that they could be built with the aid of multiple nuclear detonations (Newman,

¹ There are clear references to the bubble in the Ball Chair and the Bubble Chair designed by Eero Aarnio. The Bubble Chair has no legs, the sphere being fixed to the ceiling with a chain, and is made of translucent materials. Both models create the sense of a private and to an extent isolated space around the user and feature unique acoustics.

² During the 1960s Buckminster Fuller and Thomas Howard presented the Manhattan Dome project, their visionary objective being the upgrading of living conditions in the urban space. The geodesic dome, diameter about 3 km, would protect a given urban area from extreme weather conditions. Inside the dome, climate would be controlled and energy use diminished. Although the Manhattan Dome was not constructed, it did embody Fuller's futurist approach to sustainability and is held to be one of the emblems of futuristic architecture.

³ *The most powerful symbols derive from the most elementary perceptual sensations because they refer to the basic human experiences on which all others depend.* (Arnheim, 1977: 73)

⁴ Pneumatic construction is supported by compressed air inside its inflatable structural elements.

1969: 186). The buildings and streets of the underground city were similar to the above-ground network, with additional levels of underground spaces. Air would be recycled via air filters that went up to the surface.

RESEARCH METHODOLOGY

The paper is devoted to a depiction of the potentials of spherical constructions meant for individual housing triggered by their inevitable symbolic properties and immanent a-contextuality.

The basis of the research is a comprehensive analysis of the specimens selected as points of reference in the architectural application of the idea of the bubble in the 20th century. The methodological approach included a combination of historical evidence within theoretical frameworks as well as experimental design-driven method. The evolution of the spherical individual house was studied by using primary and secondary sources for architectural scientific research complemented with the insight into cultural, social and technological context. In addition, the focus was on the specific and variable symbolic values of sphere. Insight into the topic was created by using archival material from archival collections and various published sources specified in the bibliography, through personal contacts with selected contemporary key architects and their personal documentation, as well as by conducting the experimental design assignment that students had completed during one semester. The design assignment had been done within the course Interior Workshop in the Graduate Programme of Architecture and Urban Planning at the Faculty of Architecture in Zagreb.

HOMO BULLA EST

The origin of the metaphorical expression *homo bulla est*⁶ is a Latin saying, about the brevity of life⁷ as recorded by Roman writer and scientist Marcus Terentius Varro in his *Res rusticarum, libri tres* (Varro, [about 37 BCE] 1912: 7). During the 16th century the ex-

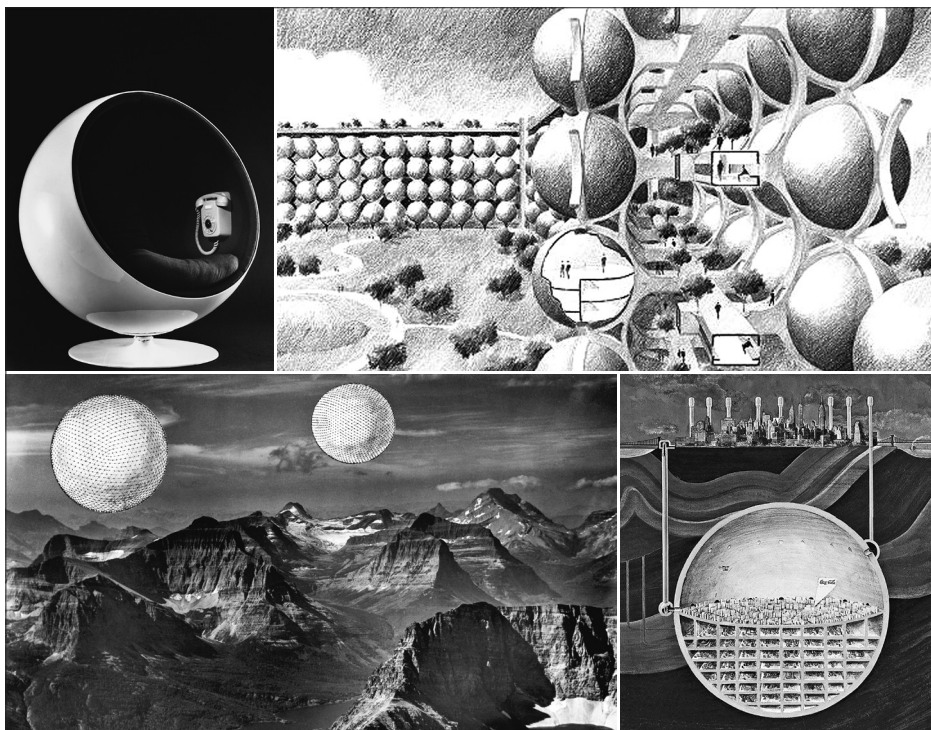
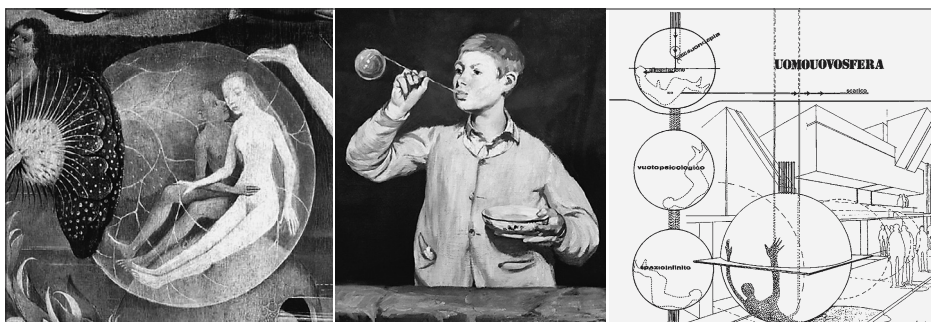


FIG. 2 EERO AARNIO: BALL CHAIR, 1963 (TOP LEFT); EDUARDO LONGO: STUDY OF A HOUSING COMPLEX, 1970s (TOP RIGHT); BUCKMINSTER FULLER AND SHOJI SADAQ: CLOUD NINE, ABOUT 1960 (BOTTOM LEFT); JEAN LAGGARIGUE AFTER A DESCRIPTION BY OSCAR NEWMAN: UNDERGROUND CITY BENEATH MANHATTAN, 1969 (BOTTOM RIGHT)

pression was popularised by Erasmus⁸, in order to emphasise the preciousness of each moment of experience as against the futility of human existence. During the 16th and 17th centuries, the *homo bulla* concept is often shown in the allegorical painting known as Vanitas⁹ in the motif of boy or putto blowing soap bubbles. The fact that at one moment the bubble will be splendid and perfect and vanish in the next is suggestively symbolic of transience. The depiction of soap bubbles continued to be used in the following centuries, but in time this symbolism linked with ideas about the futility and brevity of the human span was enriched with other interpretations involving connotations of either melancholy or else playfulness and well-being (Fig. 3). In Japanese painting the aesthetic beauty of the soap bubble was much appreciated as was the perfection of its spherical form (Mori, 1996: 172). Today the expression to be in a bubble of

FIG. 3 HIERONYMUS BOSCH: THIRD DAY OF THE CREATION OF THE WORLD, TRIPTYCH THE GARDEN OF EARTHLY DELIGHTS (*DE TUIN DER LUSTEN*), DETAIL, 1490-1500 (LEFT); ÉDOUARD MANET: *LES BULLES DE SAVON*, 1867 (CENTRE); UGO LA PIETRA: *UOMO OVOSFERA*, 1969 (RIGHT)



5 The actual name of Cloud Nine draws on the idiom to be on cloud nine, suggesting a condition of bliss. The aerial city offers to make the dream of flight, the overcoming of gravity, come true.

6 Lat. Man is a bubble.

7 ...quod, ut dicitur, si est homo bulla, eo magis senex (Lat. ...one says, if man is a bubble, he is all the more so in his old age)

8 Erasmus quoted this Latin saying in his work *Adagiorum Collectanea*, published in 1500.

9 Vanitas (Lat. vanity) is a kind of genre painting with symbolic motifs that prompt thoughts about values and priorities and promote higher ideals referring to the transience of this earthly life.

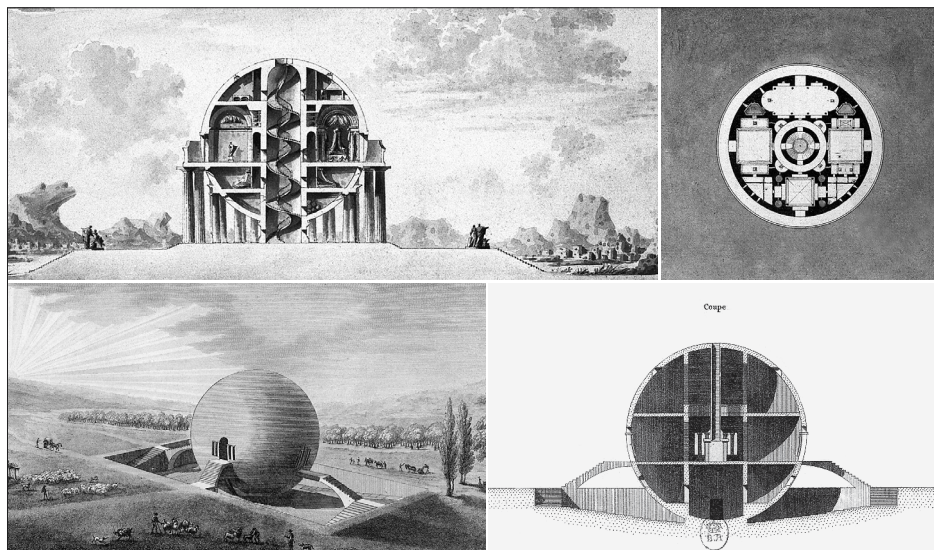


FIG. 4 ANTOINE LAURENT THOMAS VAUDOYER: DESIGN FOR A HOUSE FOR A COSMOPOLITE, 1783 (TOP LEFT AND RIGHT); CLAUDE-NICOLAS LEDOUX: MAISON DES GARDES AGRICOLES, MAUPERTUIS, 1804 (BOTTOM LEFT AND RIGHT)

one's own is often used to describe a particular state of awareness or immersion in one's own thoughts and a flight from reality.

MINIMAL SURFACES: A COMBINATION OF MATHEMATICAL MODEL AND ARCHITECTURAL CONCEPT

Bubbles and films of a soap and water solution are examples of the mathematical concept of minimal surface. Individual bubbles are always spherical. The surface tension of the film of soapy water and the pressure of air inside the form created arrive at an equilibrium thanks to the bubble taking on the

form of sphere or the geometrical form that has the least possible surface area for the given volume. The first systematically to research into the geometry of the bubble and soap films was Joseph A.F. Plateau, who formulated the general rules governing the forms of possible surfaces. The basic principle of the geometry of soapy water films and bubbles runs: *A physical system will remain in a certain configuration only if it cannot readily change to a configuration with less energy* (Almgren and Taylor, 1976: 83).

Models of minimal surfaces or forms that minimise the surface area can be made by dipping a wire loop into a soap solution, the soap film forming a minimal surface restricted and defined by the framework chosen. Multiple experiments in this field were carried out by the architect Frei Otto, who brought in the concept of form-finding, referring to the use of physical models as means for discovering forms with the use of the smallest possible amount of materials and energy (Zexin and Mei, 2017: 1).

In 1961 Otto started off a sequence of experiments with bubbles according to the minimal area principle. A special machine was constructed for the purpose of systematically recording and measuring the geometry of the soap film model (Serebryakova, 2016). Thanks to these experiments he managed to develop innovative avant-garde forms and constructions, specialising in light tensile and membrane structures. Frei Otto is recognised as the originator of parametric design in architecture.

SPHERES, BUBBLES, CLOUDS, CAPSULES: FROM UTOPIAN VISIONS TO TEMPORARY ARCHITECTURE

The application of ideal elementary geometrical forms like the sphere is characteristic of French neo-classicism. The best-known names here are Étienne-Louis Boullée and Claude-Nicolas Ledoux and the sphere appears as part of the composition of structures of various purposes. According to current knowledge and excepting primitive and vernacular constructions or traditional shelters considered a type of dome (Steadman, 2006: 121), the first spherical house for residential purposes was designed by Antoine Laurent

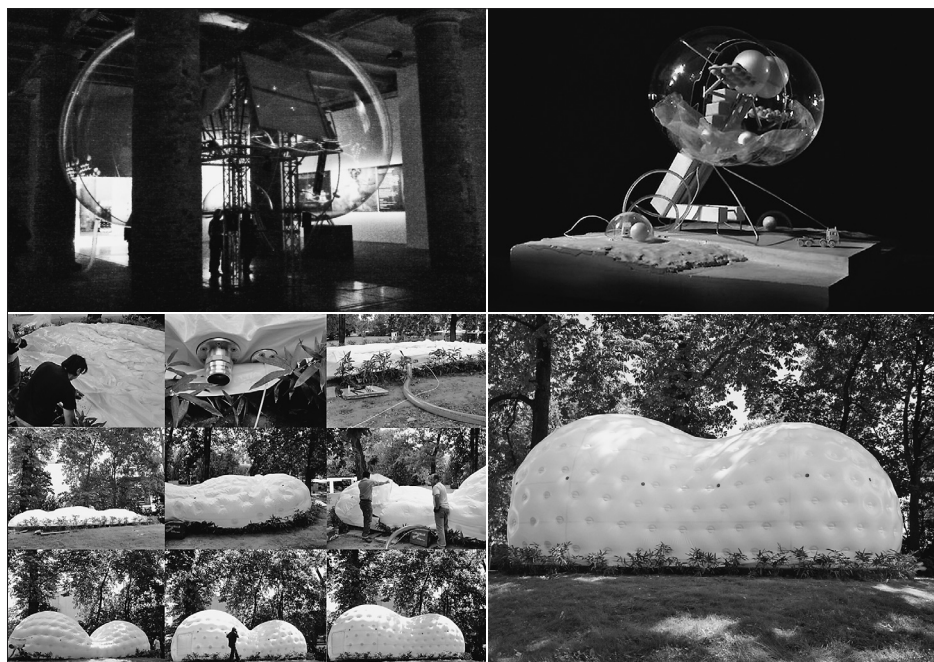


FIG. 5 COOP HIMMELB(L)AU: ASTRO BALLOON [1969] REVISITED – FEEDBACK SPACE, 2008, VENICE (TOP LEFT); COOP HIMMELB(L)AU: THE CLOUD, 1968, MODEL, PHOTO: MARKUS PILLHOFFER (TOP RIGHT); KENGO KUMA AND ASSOCIATES: FRANKFURT TEA HOUSE, 2007, PHOTOS: ANTJE QUIRAM (BOTTOM LEFT AND RIGHT)

¹⁰ Günther Zamp Kelp, one of the co-founders of Haus-Rucker-Co gave simplicity and effectiveness as the main reasons for the use of pneumatics (Mollard, 2020).

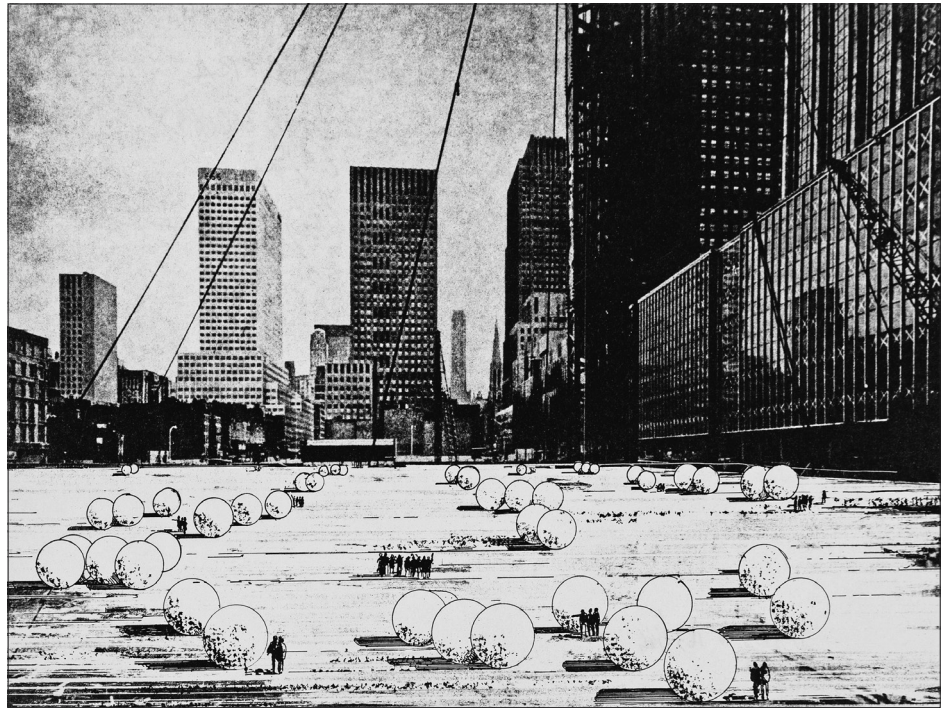
¹¹ The installation Astro Balloon was reinterpreted as Feedback Space at the 2008 Venice Biennale and at the Beijing Biennial in 2022. The heartbeats of the visitor are measured and transformed, by way of feedback into visual phenomena.

Thomas Vaudoyer for the cosmopolite, for someone, that is, who regards the whole planet as their home. Hence, probably, the choice of the sphere (Fig. 4). This is a palace, and also a temple devoted to all kinds of human knowledge. Claude-Nicolas Ledoux designed the famed *Maison des gardes agricoles* for the estate of the Marquis de Montesquieu in the commune of Maupertuis in 1804 (Fig. 4). A perfect sphere was surrounded by growing areas and was used as a shed for farm workers, containing a kitchen and four dormitories for living in and various utility and auxiliary spaces.

From the mid-20th century experimentation with the form of the bubble gained in popularity as an innovative architectural alternative that called into question the entrenched idea of the traditional home. The house of the future referencing the soap bubble was thus founded on the concept of a flexible, unconventional and open plan, with the application of technology. This was architecture as cloud, seemingly *as light as air* (Wolf D. Prix, in: Coop Himmelb(l)au, [1968] 2009).

In his 1965 article “A home is not a house”, Reyner Banham describes a contemporary house. As form of the residential space described, the artist François Dallegret proposed an inflatable transparent bubble. The ever-greater importance of complex mechanical equipment is to be seen in the dimensions and prices of devices needed for contemporary housing. Pipes, ducts, antennas, cables, heating elements, solar cells and suchlike are the main features in the design. Privacy in the traditional sense is downplayed, and the interior of the house is in visual terms part of the wider spatial environment. Banham sees the housing of the future as transportable and self-sustaining machine located anywhere in the natural environment. Architecture is fully independent of the context, reduced to the transparent membrane of the bubble, and ultimately to the consumable of mass culture (Banham, 1965: 77). Architecture is content, not envelope.

In the post-war decades, spherical architectural structures remained in most cases in the domain of utopian projects or architecture on paper: Living Capsule (Raimund Abraham, 1966), The Suitaloon (Micheal Webb, 1967),



The Cloud (Coop Himmelb(l)au, 1968; Fig. 5), *Uomouovosfera* (Ugo La Pietra, 1968; Fig. 6), Villa Rosa (Coop Himmelb(l)au, 1968). According to Wolf D. Prix, *The Cloud is an organism for dwelling, mobile and spatially changeable. The building materials are air and dynamics* (Wolf D. Prix, in: Coop Himmelb(l)au, [1968] 2009).

Some experiments, however, have been given concrete form.¹⁰ The availability of cheap polyvinyl has enabled young authors to translate the concept into reality, not as models, but on a 1 to 1 scale. Research is being conducted into the experience of almost dematerialised form along with the intensification of sensory experiences or the potentials of the human senses: Astro Balloon¹¹ (Coop Himmelb(l)au, 1969; Fig. 5), The Restless Sphere (Coop Himmelb(l)au, 1971), Balloon for Two (Haus-Rucker-Co, 1967), La Ballule¹² (Gilles Ebersolt, 1977)...

Pneumatic construction entails a membrane stabilised by compressed air.¹³ In the following decades the bubble appeared but seldom in architecture, only in some extreme situations such as for example the construction of Rem Koolhaas and Cecil Balmond in the form of a ball filled with helium above their design for the Serpentine Gallery in London in 2006, or various spatial interventions of artists and architects reminiscent of the experiments of the 1960s.

Constructions made of single layer membranes have typically been characterised as

FIG. 6 UGO LA PIETRA:
IMMERSIONI – UOMOUOVOSFERA, 1969-1970
THE IMMERSIONS ARE AN INVITATION TO QUIT REALITY AND DISCOVER A REFUGE IN A KIND OF PRIVACY THAT IS BOTH A SEPARATION AND A WAY FOR EXPLORING THE POSSIBILITIES FOR INTERVENTION THROUGH ELEMENTS THAT SHIFT AND BREAK WITH THE TRADITIONAL CODIFIED TERMS. (UGO LA PIETRA, 1967/1969)

¹² *La Ballule* is primarily meant for rolling. This is a zorb ball that was first registered technically and commercially by architect Gilles Ebersolt in 1981.

¹³ In 1917, Frederick W. Lanchester was the first to patent an air-supported structure; in 1920 he registered a patent for an air-supported exhibition hall with a dome diameter of 329 m. Although these structures were not built, both designs were published in key architectural publications and can be considered prede-

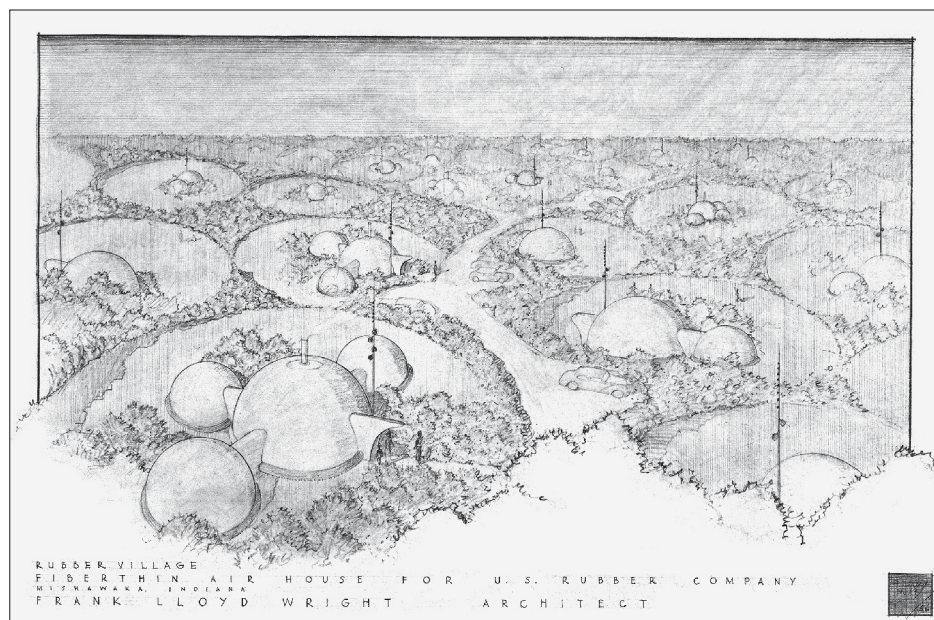


FIG. 7 FRANK LLOYD WRIGHT: RUBBER VILLAGE – FIBERTHIN AIR HOUSES, 1950S

transient and temporary. However, membranes with double walls have been used as durable building systems for composite pneumatic constructions. When ethylene tetrafluoroethylene (ETFE), a sturdy, recyclable, transparent and very light material, was introduced, architects began to use pneumatic technology in their structures. Particularly notable examples include: the Allianz Arena in Munich (Herzog & de Meuron, 2005), the Media TIC Building in Barcelona (Enric Ruiz-Geli, 2009), and the Water Cube in Beijing (PTW Architects, 2008). In his Frankfurt Tea House (Fig. 5), Kengo Kuma wished to achieve a breathing architecture, meaning the incorporation of the dynamics of breathing as metaphor for interactivity with the environment. A double-skinned membrane filled with air is made of a soft, light and translucent material called Tenara. The two membranes are fastened together with polyester tape. Breathing architecture is an attempt to get as close as possible to the original character of the ephemeral space for the tea ceremony, in contrast to the *nonbreathing concrete architecture of the 20th century* (Kuma: 2007).

MATERIALISATION OF THE BUBBLE IN DURABLE SPHERE FOR HOUSING

The first constructed spherical building is reckoned to be the *Kugelhaus*¹⁴ built in 1928 to a design by Peter Birkenholz, while the first housing structures inspired by the soap bubble and built with the pneumatic technique were put up in Falls Church to a design of Wallace Neff during World War II (Head,

2011: 34). Neff called this technology *airform*. After a circular concrete slab was poured for the foundation, a balloon was sprayed with a kind of concrete known as gunite. After the concrete was cured and set, the balloon was deflated. Such a manner of construction enabled homes to be built in 48 hours. The architect was convinced that the speed, simplicity and economy of this kind of construction would provide an answer to the housing crisis of the middle of the 20th century (Head, 2011: 13, 15). Bubble Houses in Hobe Sound, completed in 1954 and designed by Eliot Noyes, used Neff's *airform* system.

In the late fifties, Frank Lloyd Wright and the United States Rubber Company joined forces on an experimental project and prototype of an inflatable dome known as the Fiberthin Air House (Fig. 7). The approachable and practical shelter 6 m in diameter was conceived as a temporary dwelling space or as a vacation home. The use of robust nylon covered with vinyl and known as fiberthin was envisaged (Frank Lloyd Wright Foundation, 2019). Although the project was never fully articulated and the prototypes were not used successfully in practice, the Fiberthin Air House shows the continuity of the application of the bubble concept in architectural terms and in the context of residential applications.

During the 1950s Johann Wilhelm Ludowici constructed spherical house prototypes¹⁵ 4.5 m in diameter. A dwelling for two people consisted of kitchen, bathroom and a combined living and bedroom. It was imagined as being constructed in lightweight reinforced concrete, in metal or in plastic. The transportable construction was primarily meant for use in crisis or emergency situations (Science and Mechanics, 1961: 57-58).

The first practical example of a geodesic dome¹⁶ used for individual housing was

cessors of the new technology (McLean, 2018: 921). Air-formed structures or designs for enclosed spaces entirely supported by air pressure differentials were developed by Walter Bird and Dante Bini.

¹⁴ The building was put up in Dresden in 1928 but was demolished in 1938. Constructed for the annual exhibition Technical City it functioned as an exhibition space with a panoramic restaurant on the top floor. The 24 m diameter sphere of steel frame construction was placed on an 11.5 m diameter cylinder. The final façade layer was made of sheet aluminium.

¹⁵ The only example was restored in 2002 and can be visited in the *Ziegeleimuseum* in Jockgrim.

¹⁶ The geodesic dome was invented by German engineer Walther Bauersfeld, who was also the inventor of the modern projection planetarium. The dome was put up to house a planetarium on the roof of the Carl Zeiss factory in Jena, opened in 1926. Fuller popularised the construction in the late 1940s. Jeffrey Lindsay, a student of Fuller, produced the dome known as Weatherbreak in 1950. Additional help came from sculptor Kenneth Snelson, who made spatial constructions, researching

called Weatherbreak and put up as a self-supporting geodesic dome founded on the shape of a triangle. It was constructed in 1950 by Jeffrey Lindsay in accord with the ideas of Buckminster Fuller¹⁷ (Moonan, 2023). The Weatherbreak dome embodied a new system of construction, impervious to gusts of wind and blizzards. It could be put up in two days with light and accessible materials, simple tools and with only a small on-site crew. It was put up in a suburb of Montreal, but Lindsay ceded it to Bernard Judge for him to use for the construction of his own Dome House. With his project for a site in the Hollywood Hills, Judge wanted to examine the economics and applicability of the geodesic dome for residential purposes. In 1962 a structure known as the Triponent House¹⁸ was completed with state-of-the-art technology; it was also the first constructed work of architect Judge. The dome¹⁹ had a diameter of 15 m, while the core housed all the elements related to utility systems. The main characteristic of the interior space was its complete openness to the panoramic views, its open plan floor area that permitted the flexible formation of functional units (Fig. 8). Judge used the building for a short time and then disassembled it, relocating it once more, this time in the Smithsonian National Museum of American History (Moonan, 2023).

The works of Buckminster Fuller are particularly inspirational, revealing the ongoing endeavours to find an optimal, autonomous and sustainable *machine for living in*, dominated by the application of the sphere. The Dome Home or Bucky Dome (Fig. 8), the home of Buckminster Fuller himself, was located in Carbondale. It was used by the Fullers as their residence between 1960 and 1971. From 1938, Fuller made use of the term *ephemeralization*, meaning the ability of

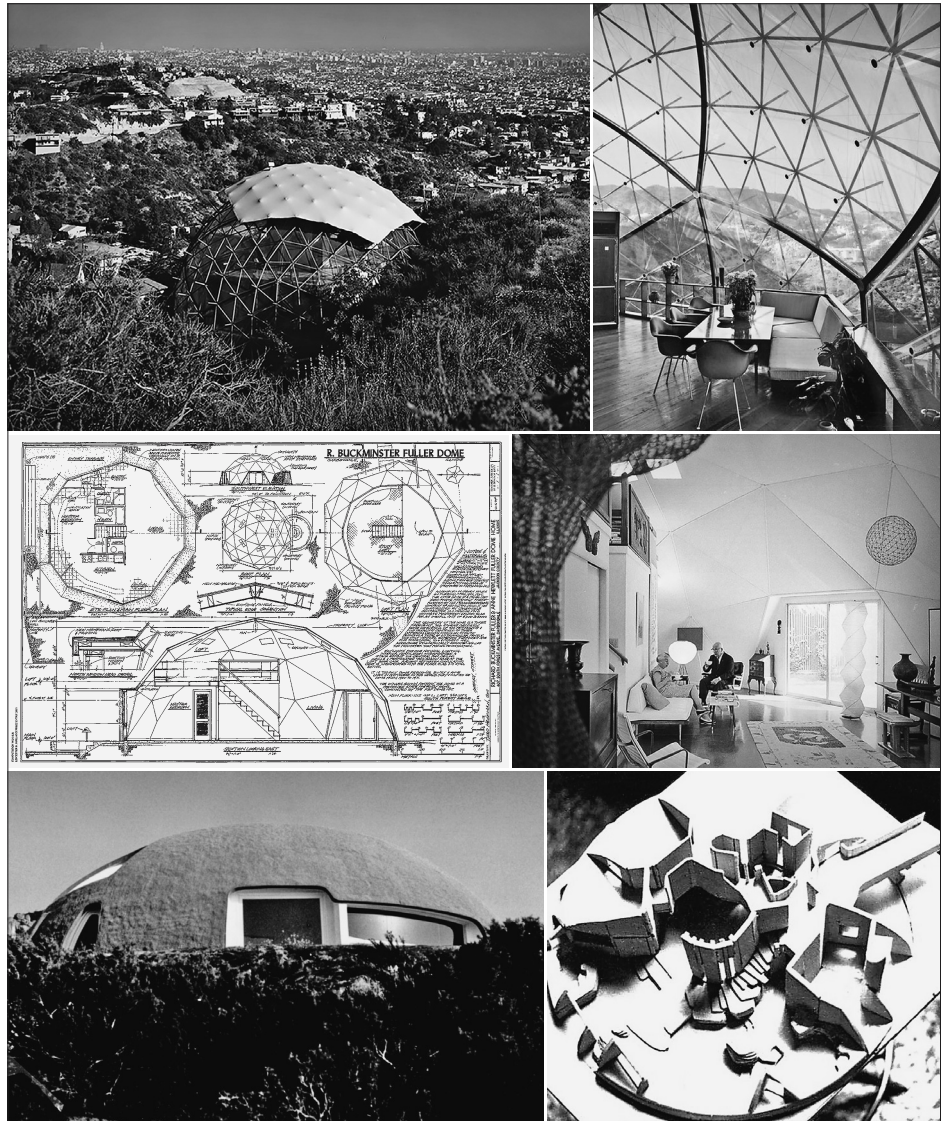


FIG. 8 BERNARD JUDGE: TRIPONENT HOUSE, HOLLYWOOD HILLS, 1959-1962, PHOTOS: JULIUS SHULMAN (TOP); RICHARD BUCKMINSTER FULLER, BUCKY DOME, CARBONDALE, ILLINOIS, 1960 (MIDDLE); DANTE BINI: LA CUPOLA, COSTA PARADISO, 1970 (BOTTOM LEFT); DANTE BINI: LA CUPOLA, MODEL (BOTTOM RIGHT)

the relation between tensile and compressive forces, known as tensegrity (Moonan, 2023).

¹⁷ Over the course of time Fuller and Lindsay stopped working together, because of a dispute over intellectual property rights to the dome, Fuller being granted the first patent in 1951, but using the drawings by Lindsay for Weatherbreak.

¹⁸ Triponent House was chosen as the name to reflect the three basic elements: envelope, core and characteristic interior spaces.

¹⁹ The dome was covered by Mylar – polyester film of remarkable mechanical and chemical properties. It is partially shaded. It was dismantled at the end of the 70s and moved to the Smithsonian National Museum of American History.

²⁰ Fuller built three Fly's Eye Dome prototypes of different diameters. The current owners of these specimens are Norman Foster (Ø 12-foot), Craig Robins (Ø 24-foot), and Crystal Bridges Museum of American Art, Bentonville (Ø 50-foot). (Moonan, 2023)

technological advances to do more and more with less and less until eventually you can do everything with nothing (Fuller, [1938]1973: 252-259). He highlighted the rapid increase in efficiency as the ineluctable direction of development and a means through which to achieve an ever-greater standard of living for a constantly growing population. From this point of view, the choice of spherical geometry and the construction of the geodesic dome was consistent with the fact that the sphere encloses the greatest volume for the given ground plan. Fuller's tensegrity structure uses the least possible amount of material to enclose the sphere (Fuller, [1938]1973: 252-259). The Fly's Eye Dome²⁰ was the last prototype he designed, in 1965, intended as a solution for an economical and portable residential space with the emphasis being



FIG. 9 EDUARDO LONGO: CASA BOLA, SÃO PAULO, EXTERIOR VIEW, PHOTO: CHICO PRESTES MAIA (TOP LEFT); VIEW OF THE SEATING AREA ON THE TOP MEZZANINE, PHOTO: CHICO PRESTES MAIA (TOP RIGHT); EDUARDO LONGO: CASA BOLA, PLANS, 1974 (BOTTOM)

placed on the reduction of the constructive weight of the building. The design was inspired by the structure of the eye of a fly.

For his lightweight circular-ground-plan domed constructions, Dante Bini developed and applied the Binishell²¹ technique – a system of pneumatic formwork and inflated membranes used in the pouring of the reinforced concrete shell. As in the airform technique of Wallace Neff, the formwork was deflated after the hardening of the concrete. The most important advantages of the *pneumoform*²² procedure were the simplicity of construction, the economisation of on-site labour and the radical reduction of the amount of material required. The binishell was developed with the objective of producing affordable, safe and interesting structures of various dimensions and for different purposes that would have a minimal impact on the environment.

La Cupola on the Sardinian coast is the best-known house of Dante Bini.²³ It was put up with the binishell technique in 1970 for director Michelangelo Antonioni and Monica Vitti (Fig. 8). The dome is 20 m in diameter, and the shell is 12 cm thick at the base tapering to 6 cm at the top (Bonomo, 2023: 189). The interior space is defined not only by the segments of the sphere but by asymmetrically deployed apertures, a rather unconstrained ground plan geometry achieved with vertical partitions between the spaces and the main double-height

living area with large windows and a sea view. The access to the front door is by pedestrian bridge. The functional elements of the interior are made to comply with the uncommon geometry of the space. The oculus over the small interior garden is the central circular aperture that enables the enjoyment of rain and the sound of the sea. The simple exterior is the result of the agreement between client and architect to let the form merge into the landscape (Bonomo, 2023: 189).

The Brazilian architect Eduardo Longo selected the form of the sphere as ideal for individual houses, conceived as systems of prefabricated modular spheres with a total ground plan of 100 m² (Fig. 2). His Casa Bola²⁴, 8 m in diameter with an area of 135 m², was built on top of his own family villa in São Paulo as spatial model suitable for a future lifestyle. He developed the idea from 1972; from the 1980s, the sphere was a part of his residence. The structure is made of steel pipes. The outer walls consisted of three layers: an outer layer of reinforced mortar, an extruded polystyrene layer of 2 cm and an inner layer of plastering. A few years later, an extra layer of polystyrene was added and on top of that a shell of aluminium (Fracalossi, 2014). All the angles of the building are rounded. The perimeter surfaces and fixed furniture are white, appearing to be monolithically constructed. The design, furniture and fittings evoke the interiors of naval architecture. The sphere has six half-floors with centrally located communications, ceiling height varying from 1.8 m to 4 m in the upper half of the sphere. The unified space at the top is articulated with variations in the height of the floor and a gallery motif. The main space features panoramic views and an oculus at the highest point (Fig. 9).

The Bolwoningen estate built in 1984 consists of 50 self-supporting fibreglass spheres, 5.5 m in diameter, each placed on a 3 m di-

²¹ In addition to Binishell, the Binistar, Binishelter, Binix, and Minishell systems were also patented. Domes of various dimensions have been built for diverse purposes and in various locations. The construction technique was patented in 1964, and the first concrete shell was erected in 1965. Nicolò Bini, Dante Bini's son, is the architect of the villa of Robert Downey Jr in Malibu, a more recent example of the Binishell system's application from 2022.

²² The coinage pneumoform was used by Dante Bini for this pneumatic formwork.

²³ Rem Koolhaas, while the curator of the Venice Biennale of Architecture of 2014, officially declared the home of Antonioni and Vitti to be one of the most significant expressions of residential architecture in the last 100 years (The Plan, 2022).

²⁴ Spherical House

²⁵ The mandatory course Interior Workshop is worth 3 ECTS credits.

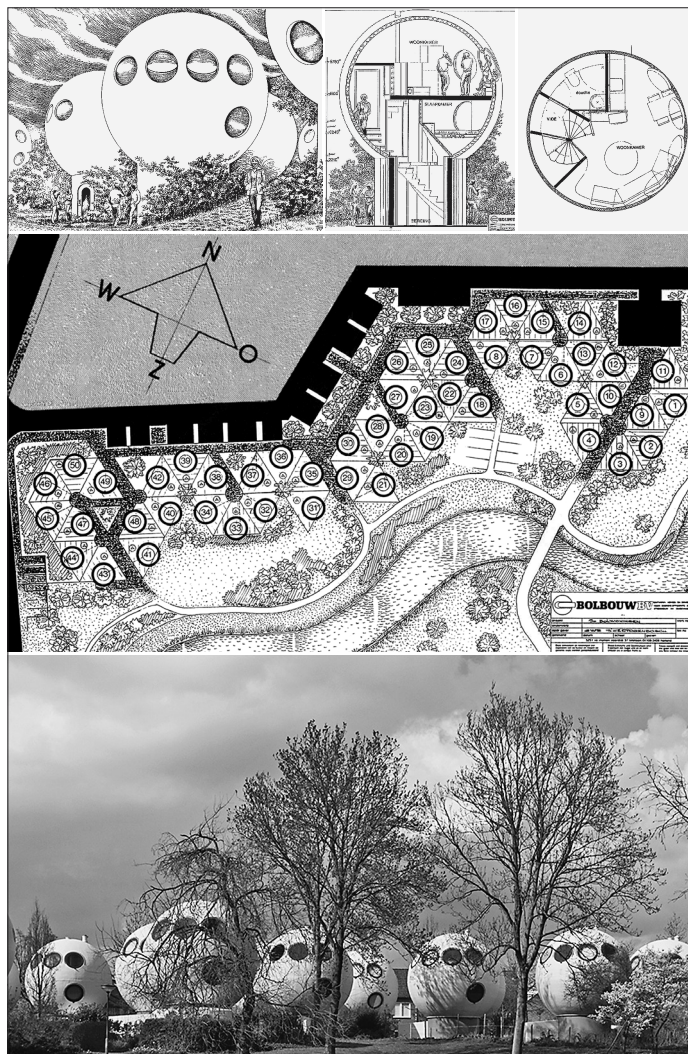
ameter cylindrical base (Fig. 10). Each sphere consists of two joined hemispheres. The architect of this new morphological approach to housing on an area of 55 m² is Dries Kreijkamp. He was convinced of the large-scale applicability of these spheres weighing a mere 1250 kg – which could float or hover or be interconnected (de Graaf, 2024: 30, 31). But the attempt at the creation of a new housing typology remained at the level of isolated experiment in Den Bosch. The space meets the housing requirements of one or two persons. A spiral staircase links all the levels. The most attractive and the biggest is the living room, which occupies most of the upper half of the sphere affording panoramic views through the sequence of circular windows. The top includes an oculus motif and the space has special acoustic properties. These houses are ecologically acceptable, energy efficient and cost-effective.

The historical and contemporary examples of spherical housing discussed above illustrate both the formal possibilities and the practical challenges inherent in this architectural form. They reveal how spheres can offer unique spatial experiences, structural efficiency, and symbolic resonance, yet require careful consideration in design and construction.

CASE STUDY: THE DESIGN BRIEF FOR THE INTERIOR WORKSHOP COURSE

Building on these insights, the following case study with students of the Interior Workshop course explores how the sphere can be interpreted, inhabited, and adapted in contemporary individual housing, bridging theoretical precedent with practical experimentation.

In the academic year 2020/2021 100 students enrolled in the Interior Workshop course²⁵ in the Graduate Programme of Architecture and Urban Planning at the Faculty of Architecture in Zagreb. The design brief defined spatial units of fundamental forms – cube, cylinder and sphere. The forms had the same volumes and a reinforced concrete envelope 25 cm thick. The interior dimensions of the cube came to 5.4 × 5.4 m, the cylinder was 6 m in diameter and 5.4 m high, while the internal diameter of the sphere amounted to 6.6 m. The students were free to choose any one of the set reinforced concrete modules according to their own liking and were allowed to perforate them according to the design adopted, but the elementary forms had to be structurally well considered and recognisable in their geometrical purity. The solution had to include only the space within the given membrane, within which the students had to accommodate and define by their interior design all the spaces required for one, two or more people to live in,



for known or unknown occupants. Only 7% chose the sphere, 76% the cube and 17% the cylinder. In view of the relatively large numbers enrolled, the preferences of these future architects can be considered representative and show that only a few were ready to experiment with the form of the sphere – even in a situation in which only their own choice was concerned, without any influence of all the other factors that attend architectural design in everyday practice.

The results of this experiment can be interpreted through observations of two main topics. One is focused on the formal aspect; the other relates to the development of *new domesticity*.

Apparently attracted by the uniqueness of a striking and timeless appearance of the sphere, the students placed it in different ways: completely above ground, laid on the ground, partially underground, partially un-

FIG. 10 DRIES KREIJKAMP: BOLWONINGEN, DRAWINGS, DEN BOSCH, 1984; PHOTO, 2017

derwater. With their design they tried to emphasize the continuous, flowing space that emanates a sense of wholeness and connection with nature.

The designs produced (Fig. 1) confirm that the spatial organisation of the interior is characterised by openness and a liberal formation of the ground plan, which is dominated by one large space in order to facilitate a more direct experience of the sphere in the interior of the structure. This central or main space would not infrequently feature split level flooring and/or the gallery motif, additionally pointing up the geometry of the circumferential surface. Secondary and utility rooms are reduced to the minimum.

While the spatial envelope of spherical structures rise at varying angles and heights, the placement and design of furniture elements required careful consideration. During the design process unusual and variable vertical dimensions are experienced as both an advantage and a problem. The furniture design in some projects followed a softer, organic form with segments of the interior equipment designed as a visually integral part of the spherical membrane. Meanwhile, in other projects a counterpoint is visible between the curved membrane and freely placed, but rather conventional, furniture elements.

It seems that the oculus motif or some other types of skylights that allow even light distribution have been accepted as a formal advantage that should be incorporated into the solution.

Applied architectural motives clearly overlap with those of the solutions of the authors who devoted themselves to the design of spherical forms.

To a certain extent, the topic of *new domesticity* coincided with realised examples created in the second half of the 20th century. However, partly it went beyond implemented solutions which already existed. The students' concepts noticeably suggested a more radical move away from traditional domestic models towards a fluid one that reflect present-day, diverse ways of living much less defined by traditional functional zones. Symbolic quality of sphere that includes its use as a metaphor for individuality was supposed to

instigate these ideas of adaptable contemporary spaces with evocative values. According to one's own choice, all projects were intended for a single occupant and offered spaces of a contemplative character that gave the impression of a protected, introverted and safe places to live in.

DISCUSSION AND CONCLUSION

As is well known, the sphere is an exception in architecture. It is not probable this will change soon what is clearly confirmed by students' choices. Future architects are predominantly inclined towards orthogonal shapes, and only a small percentage are willing to experiment with the shape of a sphere. However, there exists a continued and persistent affinity for designing individual housing spaces outside of the orthogonal pattern throughout the history of architecture up to the present time.

As a result of this research, the following key factors for choosing a sphere for individual housing were identified: rapidity of construction, the possibility of pre-fabrication, strength and durability, superior energy efficiency, efficient material use, natural air and light circulation, symbolism, attractive user's experience. Furthermore, the results of student design assignment confirmed that the sphere could support a *new domesticity* concept by creating symbolic spaces and re-inventing contemporary living environment. Although there are challenges when designing the interiors of such spaces, unique spatial experience can be a sufficient argument for such a formal choice.

It follows, then, that as sophisticated materials and methods of construction develop, further applications of sphere in the domain of housing can be expected. A movement away from the dominance of orthogonal geometry in the direction of the regular sphere can be triggered in several ways. But the common feature of spherical works of architecture is the ineluctable effect of the exceptional and the unexpected. As powerful symbolic devices spheres evoke ideas from timeless to futuristic, while associated with elemental, abstract and with historical examples.

Regarding the spatial design and functional potential, the research can be further directed towards more elaborate and innovative interior design strategies that adapt to the challenges posed by curved envelope. As well as functional aspects, it is important to examine how does living in a spherical space influence the psychological well-being, sense of comfort, and daily life experience of inhabitants compared to traditional orthogonal living environments.

In terms of formal composition the research can be enlarged to cover housing architecture that is defined by smaller or larger modifications of a geometrically regular sphere (e.g., Matti Suuronen: Futuro House, 1968) and/or to structures for individual housing with more complex formal characteristics founded upon spherical and circular geometry (e.g., Antti Lovag: Maison Bernard – *Le Palais Bulles*, Théoule-sur-Mer, 1989).

As for structural feasibility, the research can be aimed at innovative structural systems and building materials that are most effective in constructing durable, cost-efficient, and easily replicable spheres for individual housing. Similarly, it would be worth precisely investigating to what extent does the sphere offer superior structural integrity, resilience against natural forces and material efficiency compared to conventional housing forms.

Considering sustainability and environmental efficiency, some future research may provide answers to what extent does the optimal surface-to-volume ratio of a sphere contribute to superior energy efficiency compared to a rectangular building of similar volume, considering factors like natural convection and ventilation.

Furthermore, from the point of view of urban regulations, the regulatory and building code challenges are involved in constructing spherical homes, so future research could determine which design approaches can facilitate easier permitting and acceptance.

This study demonstrates that spheres, despite their uncommon status in individual housing, offer unique architectural, structural, and experiential potentials that merit further exploration.

[Translated by Graham McMaster]

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Conceptualization: D.V.I. and B.I.; methodology: D.V.I. and B.I.; software: D.V.I. and B.I.; validation: D.V.I. and B.I.; formal analysis: D.V.I. and B.I.; investigation: D.V.I. and B.I.; resources: D.V.I. and B.I.; data curation: D.V.I. and B.I.; writing – original draft preparation: D.V.I. and B.I.; writing – review and editing: D.V.I. and B.I.; visualization: D.V.I. and B.I.; supervision: D.V.I. and B.I.; project administration: D.V.I. and B.I. Both authors have read and agreed to the published version of the manuscript.

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SOURCES OF ILLUSTRATIONS

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- FIG. 2 Image courtesy of Eero Aarnio Originals (top left); Image courtesy of Eduardo Longo (top right); Image courtesy of The Estate of R. Buckminster Fuller (bottom left); *Esquire*, Dec. 1969, pp. 187 (bottom right)
- FIG. 3 Prado Museum, Madrid – Public Domain, via Wikimedia Commons. Available at: https://commons.wikimedia.org/wiki/The_Garden_of_Earthly_Delights [Accessed: 07 April 2025] (left); Calouste Gulbenkian Museum, Lisbon – Public Domain, via Wikimedia Commons. Available at: https://commons.wikimedia.org/wiki/File:Boy_Blowing_Bubbles_Edouard_Manet.jpg [Accessed: 07 April 2025] (centre); Image courtesy of Drawing Matter (right).
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- FIG. 8 Bernard Judge Papers, Architecture and Design Collection, Art, Design & Architecture Museum; University of California, Santa Barbara (top left and right); Historic American Buildings Survey via Library of Congress. Available at: <https://www.loc.gov/item/il0995/> [Accessed: 07 April 2025] (middle left); Image courtesy of The Estate of R. Buckminster Fuller (middle right); Image courtesy of Nicolò Bini (bottom left and right)
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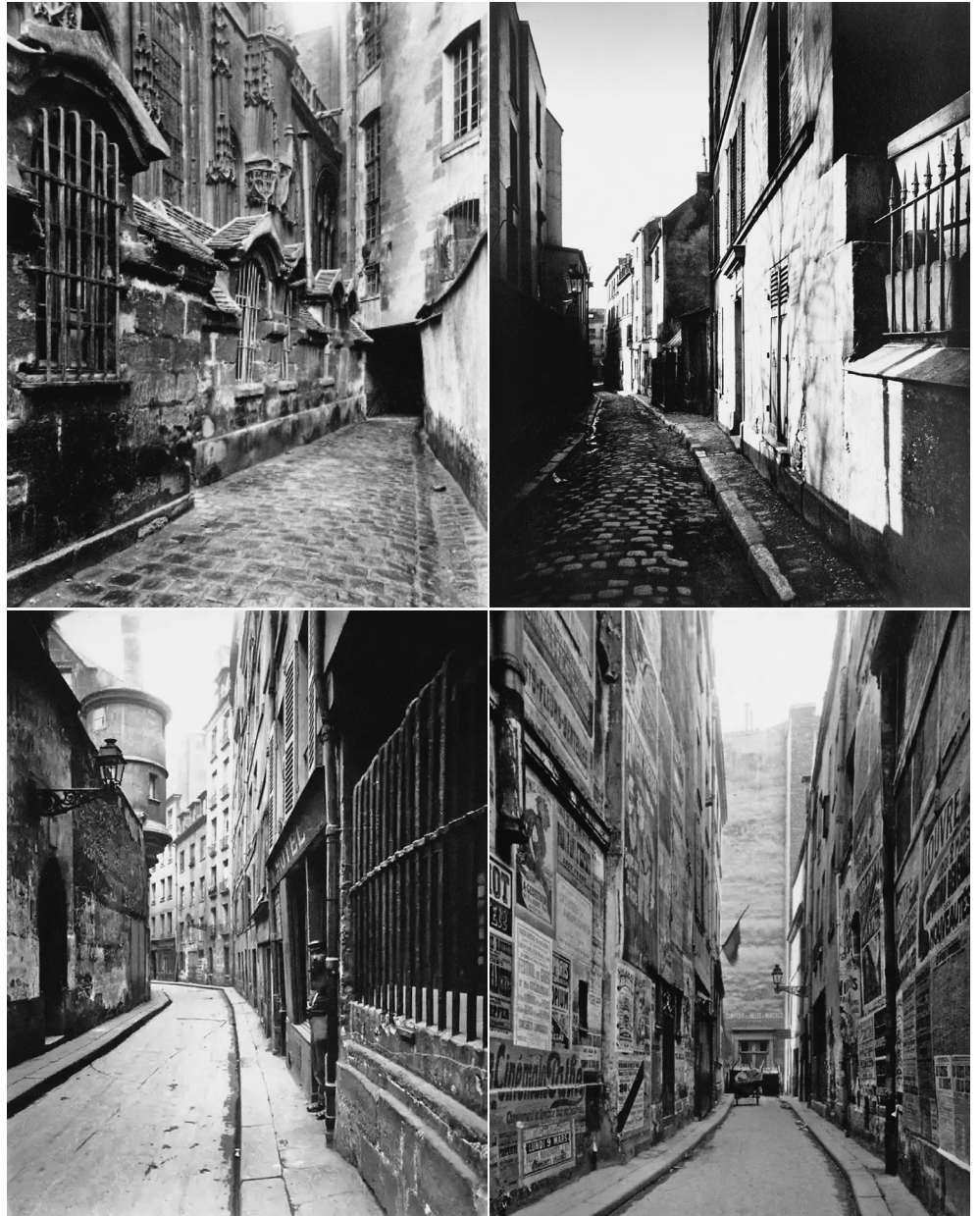


FIG. 1 PHOTO-COLLAGE GENERATED FROM A GOOGLE IMAGE SEARCH FOR "EUGÈNE ATGET EMPTY PARIS STREETS"



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SPACE AS EXPERIENCE: A COMPARATIVE READING OF ARCHITECTURE AND FILM

ARCHITECTURAL SPACE

CINEMATIC SPACE

DIALOGUE DIAGRAM

SPATIAL EXPERIENCE

This paper explores how we perceive, conceptualize, and ultimately construct architecture by examining the evolving definition of architectural space through its dialogue with cinematic space. While architectural space has historically shifted in meaning alongside changes in perceptual and theoretical frameworks, this study argues that these transformations become more intelligible when viewed through the lens of film, whose experiential and temporal nature closely mirrors human perception of the external world. Drawing on insights from film theory, the research seeks to enrich the understanding of contemporary architecture and refine the terminology used to describe spatial experience. Cinema serves not merely as an analytical tool but as a parallel medium in which architecture actively

participates in shaping narrative, atmosphere, and psychological orientation; even in the absence of human figures, the camera's movement through space evokes emotion, memory, and embodied presence. The paper is organized into three parts: the first traces the historical and theoretical development of architectural and cinematic space as intertwined conceptual constructs; the second examines how film mobilizes architectural form to generate atmosphere, symbolic meaning, and affective charge; and the third discusses a design workshop in which architectural drawing functions as a mediating device for translating spatial insights between film and architecture, demonstrating how the interplay between these media can open new ways of thinking about, experiencing, and redefining space.

INTRODUCTION: EXISTENTIAL SPACE IN ARCHITECTURE AND CINEMA

“Regardless of the essential differences in their ontological basis and artistic technique, both film and architecture are fundamentally engaged in one and the same issue: the expression of the human existential experience and this motif unavoidably projects a concept of lived space.”

(Pallasmaa, 2007)

This part of the research deals with the comparison between *architectural space* and *cinematic space*, and it is approached through two key *concepts* – architectural *space* and the cinematic *image*. The research is based on the premises of the French post-structuralist philosopher Gilles Deleuze, who proposes a radical philosophical interpretation of cinematic expression (Deleuze, 1986). Instead of understanding film as an illustration of narrative structures or aesthetic categories, he conceives it as a specific mode of thinking, that is, as the creation of *images* that enable the emergence of new philosophical *concepts*. Deleuze introduces the terms of the *movement-image* and the *time-image*, thereby defining two main types of cinematic images. The thesis presented in this paper posits that an analogy can be made between Deleuze’s concepts of the movement-image and the time-image and the evolving understanding of architectural space within architectural theory. Both domains illustrate a shift away from representational models based on functional causality towards paradigms that prioritize experience, duration, and the openness of the perceptual field.

SHIFTING THEORETICAL PERSPECTIVES ON ARCHITECTURAL SPACE

Before 1900s, architects did not speak of space as a technical category or as a concep-

tual whole. Architecture was primarily concerned with form, structure, and function, while space was regarded merely as the “empty volume” enclosed by walls. It was only at the end of the 19th century that the German theorists Gottfried Semper and August Schmarsow articulated the concept of *space* (Germ. *Raum*) as an active and defined phenomenon in architecture. In Semper’s complex architectural system, which consisted of four fundamental elements – the *hearth*, *roof*, *enclosure*, and *mound* – space was a specific and unique entity, defined by the central element of the *hearth* from within, and by the element of *enclosure* from without (Semper, 1851, 1989). Building on Semper’s ideas, Schmarsow formally established a theory of architectural space: rather than just an abstract volume, space was conceived as the movement of the observer through architectural forms, giving rise to the notion of *Raumgestaltung* – spatial articulation¹ (Schmarsow, 1893, 1994). From around 1915 to 1923, the concept of *Raum* developed further: psychologically experienced volume (*Raumempfindung*) became the programmatic understanding of space as a three-dimensional, harmoniously composed continuum.

During the Modernist era, the theoretical framework of architecture was shaped above all by two principal works: Sigfried Giedion’s *Space, Time and Architecture* (from 1941; Giedion, 1969) and Bruno Zevi’s *Architecture as Space: How to Look at Architecture* (from 1948; Zevi, 1957). For Zevi, *space* constituted the very essence of architecture; the fundamental quality of architecture is its spatiality. Giedion, on his part, placed *space* at the core of Modernism, regarding the history of architecture as a history of successive spatial conceptions. He identified three such conceptions, each tied to a distinct historical epoch: the first was the *emanative force of volume*, in which architecture develops outward from mass into field (e.g., the Egyptian pyramids); the second was *space as a hollowed interior volume* (e.g., the Renaissance and Baroque interior spaces); and the third was the *relationship and mutual interaction between interior and exterior space* (the Modern epoch). The key moment in his theory of space is the idea of the inseparability of *space* and *time*, forming a concept of *space-time*, as a *continuum*, which he grounded in the work of the mathematician Hermann Minkowski. This introduced the temporal dimension into architectural discourse. The static vision of space, inaugurated and conditioned by the Renaissance perspective, was replaced by a dynamic, mobile, and simultaneous mode of perception. Thus, perception has transformed: space is no longer viewed as an absolute and

static category, but rather as something that is experienced through movement and shifting perspectives of the observer – commonly referred to as the *architectural promenade*.

THE MOVEMENT-IMAGE AND THE ARCHITECTURE OF REPRESENTATION

In film, space is present through movement; we experience space in the continuity of the movement of the actors, of the camera, or both. Unlike in the case of architecture, space as emptiness does not exist in film. Movement within space constitutes the *physical reality* of the world, while the *image* constitutes the psychic reality of consciousness (Deleuze, 1986). The *image* is our internal, psychological representation and experience of *space* – of that which is external in relation to us. We do not perceive film as a series of still frames; instead, we view it as an optical illusion that creates the impression of continuous movement. We experience it directly as the *movement-image*, much like we would in “real” space – meaning it closely mirrors our mental representation and experience of space. Deleuze’s *movement-image* is therefore grounded in causal structures, in which perception leads to affect, and affect to action, within the closed system of narrative economy. In architecture, an analogous model can be found in architectural tradition, all the way from Vitruvius to Modernism, where space is conceived as a rational representation, organised according to the principles of functionality, order, and proportion. Modernists, further on, sought to create architecture that controlled the movement and perception of the user through clearly defined spatial sequences. In this sense, space functions as the architectural equivalent of the Deleuzian *movement-image*: it is directed, determined, and structured by the causality of function and representation. Considering Giedion’s “third spatial conception” – where space is no longer absolute and immobile, but experienced through movement and the changing points of view – and his idea of the inseparability of *space-time*, we can observe a direct parallel with film in the same historical period, through Deleuze’s concept of the *movement-image*. In both cases, space is treated as a logical and harmonious sequence of events, with a linear, cause-and-effect narration. The experience of time is indirect, arising as a result of traversing a given space.

ARCHITECTURE AS AN EVENT

Architectural thought and theoretical discourse during the late 1980s and 1990s, as a reaction and critique of the Modernist emphasis on function, and after initial Postmodernist ideas and first structuralist concepts, turned toward post-structuralist reflections on the body, perception, time, and affect, where architecture was no longer understood merely as form, but as experience, as *event*.

Bernard Tschumi is the architect who introduces the notion of *event architecture*, both in his theoretical writings and in his practice, conceived as the interaction between space, event, and movement (Tschumi, 1994, 1996). Tschumi employs the concept of *event-space*, in which architecture is not simply a form, but rather a network of relationships between space, event, and user. He draws inspiration for his theoretical discourse from the avant-garde arts (*Constructivism, the Situationists*) and from the medium film, especially the discipline of film montage. Tschumi rejects the reduction of architecture to either form or function, since both approaches neglect the dynamic nature of spatial use. Instead, he proposes the operation of *disjunction*: architecture as a space that continually opens up possibilities for events that may ever again reshape it. Such “disjunctive” architecture brings together *space* (the physical framework) and *event* (human activity, the body, movement, programme). His approach to architecture as *framing*, as organization of spatial frameworks, and his notion of *montage of attractions* are drawn directly from film techniques, the latter from the filmmaker Sergei Eisenstein. Tschumi develops his method around three key concepts: *space* – the physical framework; *event* – activity, action; and *movement* – the dynamics of the body through space. In this way, *space* becomes secondary, serving as a physical framework, a platform for the *event*, which now takes centre stage. Architecture is therefore defined not in its stability – the built form – but in its use, its ever-changing, dynamic state. A new quality of space is thus recognised: *performability* – the capacity of space to enable diverse, unforeseen, or unexpected events – which now becomes a fundamental determinant of *architectural space*.

FROM THE MOVEMENT-IMAGE TO THE TIME-IMAGE

According to Deleuze, the transition from the *movement-image* to a different mode of creating and treating the image as the fundamental element of film begins after the Second World War, when classical linear nar-

¹ Within Schmarsow’s framework, *Raumgestaltung* referred to the process of shaping the interior space of architecture, where space is not merely an ‘empty’ volume bounded by walls, but an active experiential phenomenon arising from the relationship between human beings and architectural forms.

ration is abandoned. Instead of a logical sequence of events, we now encounter “gaps” in time, a fragmented reality, and “indeterminacy”. Deleuze calls this form of cinematic image the *time-image*. What characterises it is that in the film’s narrative, time becomes explicitly present – it is no longer merely a framework for the linear unfolding of the plot. Long takes, fixed cameras, silence, dream-like states, memories, hallucinations are now dominant. There is no clear action, and often no goal. For Deleuze, the *time-image* interrupts the logic of action: time appears directly through durations, voids, contingencies, and ruptures in the narrative, and through the breakdown of causal structures. As examples of this approach, Deleuze cites filmmakers such as Yasujiro Ozu, Michelangelo Antonioni, Andrei Tarkovsky, Alain Resnais – directors who explore inner duration, subjective memory, and suspensions in time. Deleuze derives this conception from Bergson’s notion of “duration” (*durée*) – time as a continuous flow in which past and present permeate one another.

A related transformation can be identified in architectural theory at the beginning of the 21st century, where space is no longer understood as a fixed and stable representation, but as a field of events, perceptions, and affective intensities. Architectural space thus becomes the equivalent of Deleuze’s *time-image*: open, unfinished, and capable of articulating the immediate experience of time and movement through the body of the observer. Architectural counterparts can be found in late-20th-century architectural theory. In *Architecture and Disjunction* (1994), Tschumi describes architecture as an “event” arising from the encounter between body and space. Likewise, Peter Eisenman, through his deconstructivist projects, questions the stability and representational certainty of architectural space. A comparable line of inquiry can also be found in the theoretical writings and architectural work of Rem Koolhaas.

THE CRYSTAL-IMAGE AND ATMOSPHERES – THE EXISTENTIAL SPACE OF ARCHITECTURE

A comparison between Deleuze’s typology of cinematic images and contemporary architectural theory reveals that both film and architecture share a common aspiration: the shift from a paradigm of representation toward a paradigm of event, experience, and duration. Whereas the *movement-image* corresponds to Modernist architecture and its logic of functional organisation and spatial representation, the *time-image* opens up space for an architecture that is less determined by form and function, and more ori-

ented toward creating conditions for direct, immediate bodily experience.

The theoretical foundation for such a rethinking of space is offered by Gernot Böhme through the concept of *atmosphere*, understood as an aesthetic and sensory field that links the physical, bodily, and emotional. Thinking in terms of atmosphere thus regards architecture not solely as structure, but as an event that incorporates both the user’s body and their perceptual experience (Böhme, 2017).

Deleuze’s notion of the *crystal-image* provides an additional layer of understanding; in the *crystal-image*, which is conceived as a distinct and intensified subtype of the *time-image* – designates the moment in which the actual and the virtual enter into a state of mutual indiscernibility. When transposed to architectural theory, this conceptual framework suggests that architectural space cannot be reduced solely to its material or measurable dimension; rather, it always already incorporates layers of meaning, memory, and affective resonance that exceed its physical configuration (Deleuze, 1986).

The works of Peter Zumthor, Smiljan Radic, Aires Mateus, and Junya Ishigami exemplify this approach, demonstrating how spatial experience engages not only the senses but also personal and collective narratives. These architects reveal that architecture’s significance emerges from the interplay between materiality and immaterial experience, challenging reductive readings that focus exclusively on structure or function.

² Even if reproductions do not physically alter the original artwork, they erode what Benjamin calls its “aura” – the aspect of originality, singularity, historical presence, and authenticity inherent in direct encounter with the original work of art. In mass culture, he argues, accessibility supersedes authenticity; the collapse of spatial distance enables instant digital access but simultaneously dissolves the aura. In her re-reading of Benjamin, Hito Steyerl (2012), in *The Thing Like You and Me*, contends that in an image-saturated digital culture, the capacity for copying, multiplying, and circulating images can enhance – rather than diminish – an artwork’s value, creating new forms of cultural currency and visibility. This inversion is particularly relevant for contemporary architectural experience, where mediated images – whether archival reproductions, speculative renderings, or AI-generated visualizations – do not simply document space but actively participate in shaping how it is perceived, valued, and remembered.

³ *The Architecture of Healing: Sulphurous Scapes* (43° 30.547' N, 16° 26.22' E), directed by Nina Baćun, Kino Klub Split, 2024. Developed within the Kino Klub Split’s project *Hidden City (Skriveni grad)*.

⁴ Turnheim, in *The Use of Space*, argues that architecture is shifting “away from optics and towards use,” as its visual-informational dimension dissolves, necessitating a reorientation of practice around use (2025: 15).

THE DISTRACTED AND MEDIATED EXPERIENCE OF ARCHITECTURE: PERCEPTION IN THE AGE OF TECHNOLOGICAL SATURATION

“Reception today is mediated by the pulse of the crowd, the windshield of the car, by broadcast transmissions, and by a whole series of collective codes and expectations. Tourists visit cities only to confirm impressions already formed from postcards or movies”

(Allen, 1995: 50).

This section of the text revisits Walter Benjamin's seminal essay *The Work of Art in the Age of Mechanical Reproduction* (1936, revised version), reframing its aesthetic theory within contemporary spatial and media culture. Central in this essay is Benjamin's notion of distraction as a mode of appropriation – an enduring form of engagement that resonates with today's digitally saturated environments – and which informs and sustains an experimental cinematic methodology.

Benjamin's reflections on a work of art's *aura*², reproducibility, and distraction offer more than historical insight; they provide a framework for understanding how architecture is mediated, circulated, and experienced. Benjamin's analysis of the politics of reproduction anticipates the proliferation of digital and algorithmic images shaping architectural imaginaries across networks and screens. Extending Benjamin's theory into spatial representation, the experimental essay film *The Architecture of Healing: Sulphurous Scapes* operates not as documentation but as methodological experiment.³ Through cinematic and computational techniques – including AI-generated imagery and open-source platforms – the film demonstrates how reproducibility generates new modes of engaging with architecture.

As Katja Grillner (2005) observes, the notion of reproduction itself “looks very different today” and is no longer primarily mechanical. This reflects a persistent discourse that still upholds what Benjamin criticised as “out-moded concepts, such as creativity and genius, eternal value and mystery – concepts whose uncontrolled (and at present almost uncontrollable) application would lead to a processing of data in the Fascist sense” (Benjamin, 1936: 2).

Benjamin identified a new function of art, with photography, architecture, and film as transformative examples. Eugène Atget's photographs of empty Parisian streets around 1900, resembling crime scenes, illustrate this perfectly: devoid of people, they

function as visual evidence, documenting rather than idealising (Fig. 1). Such a documentary mode soon resonated in architectural practice, where photography became a crucial – though often aestheticized – representational tool. Bernard Tschumi inverted this legacy in *Advertisements for Architecture* (1976-1977), provocatively declaring: “To really appreciate architecture, you may even need to commit a murder... Architecture is defined by the actions it witnesses as much as by the enclosure of its walls” (Tschumi Architects (1976-1977)). By reframing architecture as stage for action rather than object of contemplation, Tschumi underscored its performative dimension.

In contemporary culture, both architecture and cinema operate within regimes where *reality* is continuously filtered, edited, and staged. As Benjamin already recognised, “the equipment-free aspect of reality here has become the height of artifice; the sight of immediate reality has become an orchid in the land of technology” (Benjamin, 1936: 13). We long for authenticity yet distrust it – a paradox that highlights Benjamin's claim that what appears “natural” is always mediated through reproduction.

This condition resonates with Claudia Giannetti's “ecology of images and media” (2021), which identifies our environment as saturated with filtered hyper-representations – distorted mirrors of reality that remain largely unquestioned. In architectural discourse this is evident in 3D renderings, which present idealised visions often diverging from the built reality.

Benjamin considered architecture and cinema analogous media. Unlike traditional artworks approached through contemplation, architecture is perceived in distraction: “Architecture has always represented the prototype of a work of art the reception of which is consummated by a collectivity in a state of distraction. [...] Buildings are received in a twofold manner: by use and by perception – or rather, by touch and sight. [...] Tactile appropriation is accomplished not so much by attention as by habit... habit determines to a large extent even optical reception.” (Benjamin, 1936: 18).

The notion of habit remains a valuable reference. Max Turnheim (2025: 19) reformulates: “architectural constructions are appropriated in twofold manner – by use and by information”.⁴ Giuliana Bruno (2018) similarly highlights the emotional dimension of space, emphasising how habitual interactions shape affective experience and memory. Architecture and visual culture mediate not only physical but also psychological dimensions of space,



FIG. 2 STILLs OF SULPHUR BATHS (*SUMPORNO KUPALIŠTE*), SPLIT, FROM THE FILM *THE ARCHITECTURE OF HEALING: SULPHUROUS SCAPES* (43° 30.547' N, 16° 26.22' E), DIRECTED BY NINA BAČUN, 2024

FIGS. 3 AND 4 STILLs FROM THE FILM *THE ARCHITECTURE OF HEALING: SULPHUROUS SCAPES*, DIRECTED BY NINA BAČUN, 2024. CORRESPONDING TO THE THEMATIC STRANDS THAT STRUCTURE THE WORK.

offering layered, sensorial modes of inhabitation. As Bruno argues, “Architecture is a map of both dwelling and travel, and so is the cinema” (2018: 71), foregrounding their shared negotiation of lived and imagined space.

Benjamin further argued that cinema deepens apperception.⁵ The close-up amplifies space, slow motion prolongs movement, and both reveal hidden rhythms – what he termed the “optical unconscious”: “By close-ups [...] by exploring commonplace milieus under the ingenious guidance of the camera, the film extends our comprehension of the necessities which rule our lives” (Benjamin, 1936: 15-16).

In architectural terms, cinematic techniques expose textures, atmospheres, and temporalities that escape conventional representation. Distraction here is not a lack of attention but an adaptive mode of navigating sensory complexity. Stan Allen (1995: 48) emphasises distraction as “a new form of subjectivity that could overturn exhausted models of reception”. In architecture, habitual use trains perception, enabling users to interpret and sometimes subvert spatial codes. Within today’s media-saturated environment, digital interfaces and montage techniques – such as dispersed visual fields in social media or image-search archives – foster non-linear, fragmentary, and ephemeral engagements. Distraction thus becomes cognitive adaptability, a survival strategy for navigating mediated space.

FROM DISTRACTION TO METHOD: CINEMATIC RESEARCH THROUGH THE ARCHITECTURE OF HEALING – SULPHUROUS SCAPES

These theoretical concepts are operationalised through a practice-based inquiry that employs cinematic methods to examine mediated architectural experience. The essay film *The Sulphurous Scapes* demonstrates how moving images can serve as both analytical and generative tools in architectural research. Focusing on the Sulphur Baths (*Sumporno kupalište*) in Split⁶ – historically associated with the healing of body and spirit – the film reinterprets the site’s latent spatial and cultural narratives through cinematic means. The Baths (Fig. 2) emerge as a liminal environment positioned between order and disorder, isolation and exchange. Healing is framed as a socio-somatic interlude, suspending routine in pursuit of restoration. The film treats the site as both material artefact and conceptual threshold, where architecture embodies processes of separation and reconnection.

The ecology of care at the centre of this environment – linking body, space, and time – evokes a balance between individual and collective, internal and external. It becomes an abstract network of connections, symbolising



FIG. 5 COMPOSITION OF PHOTOGRAPHS OF THE INSTITUTE OF CONTEMPORARY ART (ICA), BOSTON, USA (2003-2006), DESIGNED BY DILLER SCOFIDIO + RENFRO. COURTESY OF DS+R. THROUGH THEIR TREATMENT OF WINDOWS AS SCREEN-LIKE MEDIATING SURFACES, THE ARCHITECTS REALISE WHAT BRUNO TERMS "ARCHITECTURE THAT READS LIKE CINEMA".

how healing spaces function as conduits for cultural and psychological renewal.

Methodologically, this essay film enabled iterative and multi-sensory inquiry, integrating text, images, sound, and montage. Three thematic strands structure the work (Figs. 3, 4): (1) *historical and spatial narratives*, blending documented and speculative accounts; (2) *the human body*, examined through cultural representations of health and illness; and (3) *the materiality of sulphur*, explored through scientific and popular imaginaries. The lack of archival documentation necessitated speculative reconstruction, prompting oscillation between factual and imagined pasts.

The creative process unfolded as a dialogue between theoretical inquiry and practical experimentation. The project aligns with David Bergé's *Architectures of Healing: Cure through Sleep, Touch, and Travel* (2021) in considering architecture through bodily experience. The *Sulphurous Scapes* also reflects on its own composition, foregrounding the architecture of the film. Through montage, rhythm, and spatial sequencing, the medium itself becomes a site of design speculation, extending the physical building into imagined futures.

This case study demonstrates that cinematic methods can expand architectural design research by revealing latent spatial narratives inaccessible through conventional documentation, and by proposing modes of representation that integrate affect, materiality, and temporality. This essay film activates Benjaminian distraction, inviting viewers to navigate frag-

mented impressions – historical traces, textures, and speculative reconstructions – rather than demanding singular focus.

ARCHITECTURE AS DISTRACTED AND IN FLUX

Benjamin's essay remains a critical reference for understanding contemporary architectural experience. His notion of distraction (*Zerstreuung*) – habitual, collective, often unconscious engagement – anticipates what Allen (1995) describes as a new perceptual literacy. Rather than perpetuating the framing of architecture as fixed and intentional, we might reconceptualise it as *distracted*, *unstable*, and *unfocused*.

Within digital culture – marked by simultaneity of images, montage of interfaces, and fragmented temporality – architecture's representation and perception increasingly resist closure. They, therefore, necessarily become provisional, adaptive, and perpetually in flux (Fig. 5).

FROM ARCHITECTURE TOWARD OTHER ARTS AND VICE VERSA

- Case study: workshops *DISPOSITION _ Dialogue Diagram / Architecture_Film_Dance* / SC Gallery, Modulator Gallery – There is an important distinction between the two membranes in which our world unfolds: the first membrane (the real world) and the second membrane (the metaworld of ideas and abstract meanings). The first membrane is the skin of the Earth, while the second is a diagrammatic inscription on the first. The behavior of each membrane influences the other and triggers certain reactions. In the metaspaces, diagrammatic models create stability in time and continuity between different positions.⁷ It is an open space for dialogue between science and various forms of art – architecture and film (Habjan, Lukač and Tutek, 2025: 85).

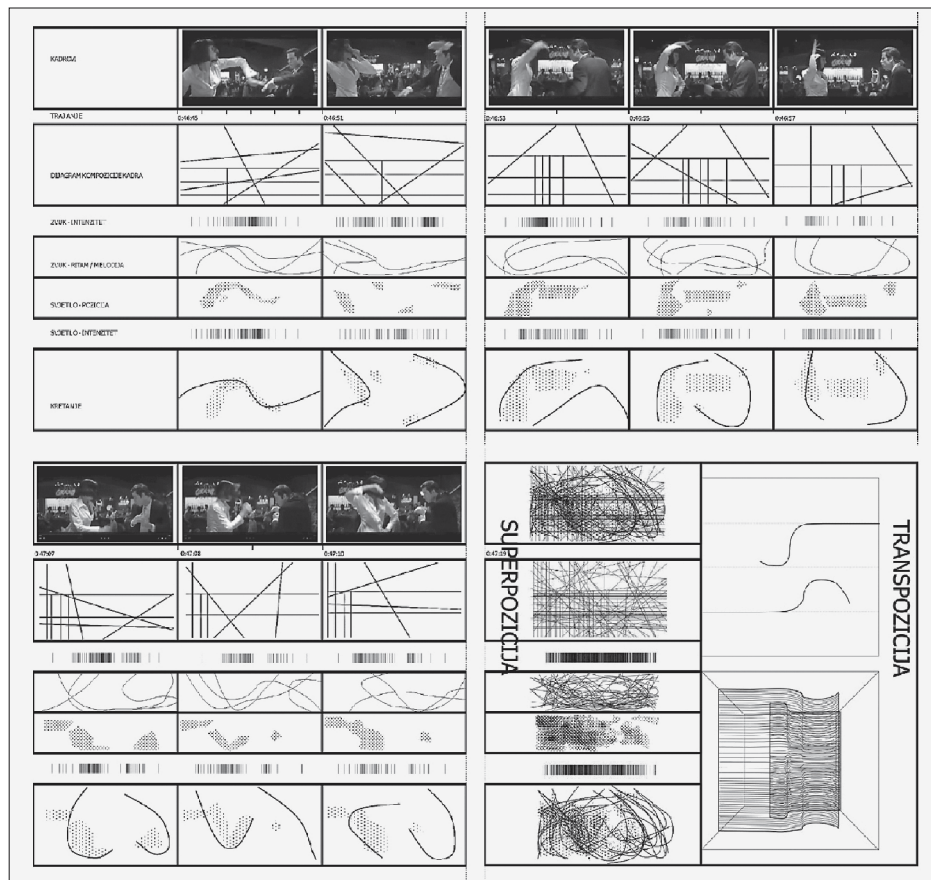
The scientific-artistic research project *DISPOSITION _ Dialogue Diagram / Architecture_*

⁵ Apperception denotes the assimilation of perception through accumulated experience (cf. Merriam-Webster, s.v. "apperception," accessed July 27, 2025).

⁶ Public building the Sulphur Baths in Split (1903), designed by Kamilo Tonic in the Vienna Secession style, was constructed over natural sulfur springs historically used for therapeutic purposes.

⁷ "Space and time are collapsing. The metropolis is inescapable, its section is a materialized horizon. Ground, the skin of the earth, is a primal horizon. The attempt to reconfigure this horizon is an essential condition of architecture." (Bunschoten, 1991: 55-59)

FIG. 6 WORKSHOP *DISPOSITION _ DIALOGUE*
DIAGRAM / ARCHITECTURE _ FILM _ DANCE, SC
 GALLERY; FILM: Q. TARANTINO, *PULP FICTION*, 1994



Film_Dance began in 2020 as part of an experimental interdisciplinary collaboration between the architects Ivana Tutek and Bernarda Lukač with the poet and multimedia artist Stanislav Habjan, involving various projects: architectural designs and realizations, student workshops, as well as exhibitions, performances, and publications.⁸

The project explores and presents the movement from architecture towards other arts and vice versa through abstract compositional diagrams. These experimental studies are based on the abstract conceptual assumption that the processual compositional models – the suprasensible diagrams present in the structure and formation of any artistic work – allow communication between artistic media, but also between artistic, scientific, and technical disciplines as a whole, transforming and upgrading the basic structure in the domain of a new medium.

DISPOSITION _ Dialogue Diagram / Architecture_Film_Dance workshops took place at the SC Gallery in February and at the Modulor Gallery in October 2024. Undergraduate students in architecture designed the final frame of the diagram – the transposition of ele-

ments from the medium of film (a selected or specified film segment) into a compositional diagram of architecture (a free spatial form or element that determines spatial relationships in a unique way), presented in the form of a digital drawing or collage (Figs. 6, 7).

The main layout for this transposition is based on notations prepared by Sergei Einstein for his film *Aleksander Nevski*. They serve as a revelation – a simultaneity and a multiplicity of information that combine frames, musical scores, montage or composition diagrams, movement diagrams. Its principal elements are transposed into architectural terms.

This model was used as well in a similar way also in the experimental project *Joyce's Garden*, designed by Bernard Tschumi. He gave excerpts of literary texts as programs to stu-

⁸ The project *DISPOSITION _ Dialogue Diagram / Architecture_Film_Dance* has been conducted as part of the institutional research at the Faculty of Architecture in Zagreb since 2022. Art project *DISPOSITION _ Dialogue Diagram* is presented through authors' lecture, exposition and publication at the CA2RE Conference / Dispositions, November 7-9, 2024, Belgrade, EAAE.

⁹ The display of fireworks in 1992 became a three-dimensional, ephemeral version of the organization of

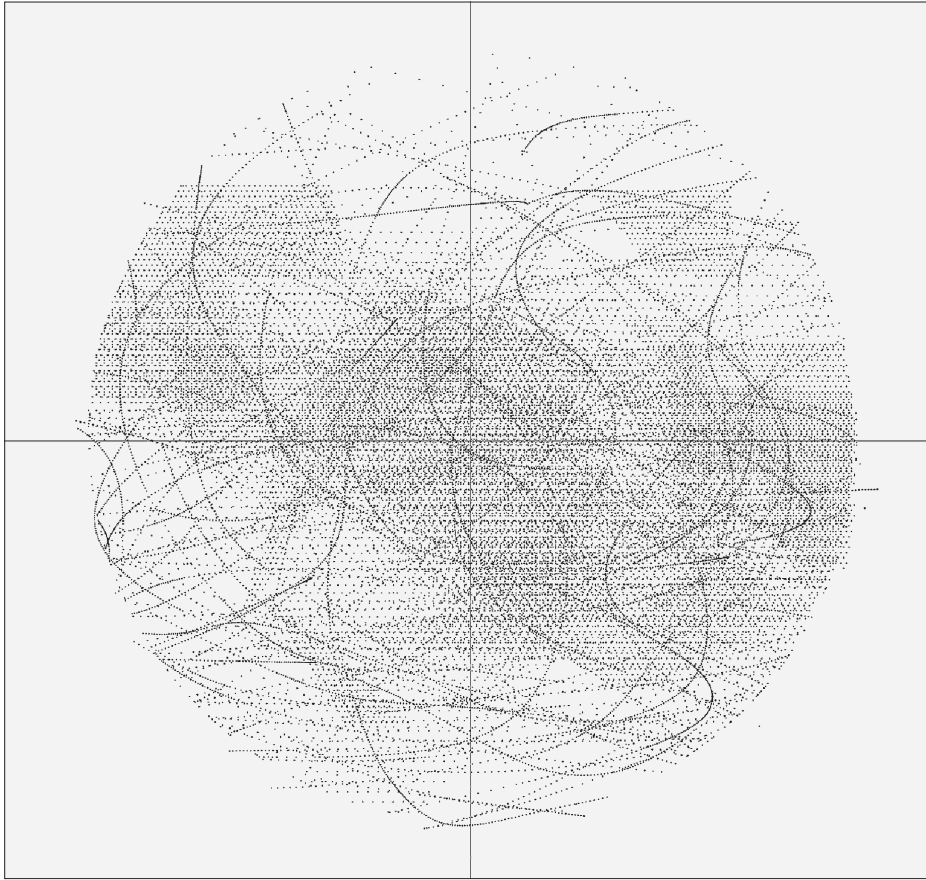


FIG. 7 WORKSHOP *DISPOSITION _ DIALOGUE*
DIAGRAM / ARCHITECTURE_FILM_DANCE, SC GALLERY

dents in order to suggest cross-references between architecture and other disciplines. In his *Fireworks* project, further on, Tschumi wanted to express fireworks in perspective, plans, and elevations, while also indicating things like colour, intensity, and duration. He developed his own mode of notation. It indicates the folies, the movement vectors, and how they interact with one another. Each of the frames corresponds to a seven-second interval in the firework – that is the basic time frame.⁹ Bernard Tschumi, in his book *The Manhattan Transcripts*, articulates a complex range of architectural conditions (through the categories of events, movement, and space). By rearranging diagrammatic forms and concepts from film – integrating complex scenes and scenarios – he creates an architectural diagrammatic system that describes the interaction between space and move-

ment of bodies. The Parc de la Villette was the first project in which Tschumi successfully applied the new diagrammatic tools, techniques, and theories developed in *Manhattan Transcripts*. There, the superimposition of points, lines, and fields is simultaneously a superimposition of action, movement, and space. For Tschumi, a diagram is a graphic representation of a concept, while architecture is the materialization of that concept. Thus, the diagram is one of the initial phases in the architectural creation process, which may later become visible or only implied (diagrammatic visibility).¹⁰

All of these examples served as a starting point and primary inspiration in student workshops *DISPOSITION _ Dialogue Diagram / Architecture_Film_Dance* for creating a parametric compositional diagram in which the choreography within the set film frame was geometric, graphic and intuitive simultaneously (Fig. 8). The introductory part of the event included lectures and screenings of selected films by invited authors¹¹ accompanied by an exhibition of works displayed in two parts: as an introduction (workshop mentors' exhibition) and a conclusion (students' works). The exhibitions complement each other and form a thematic whole.

Tschumi's Parc de la Villette, namely, the superimposition of the three systems of points, lines, and surfaces. A system of notation organized and defined the events in space and time. (Migayrou, 2014: 114)

¹⁰ According to: M. Garcia (ed.) (2010), *The Diagrams of Architecture*, London: John Wiley & Sons Ltd.

¹¹ Nina Bačun, Alan Kostrenčić and Vladislav Knežević

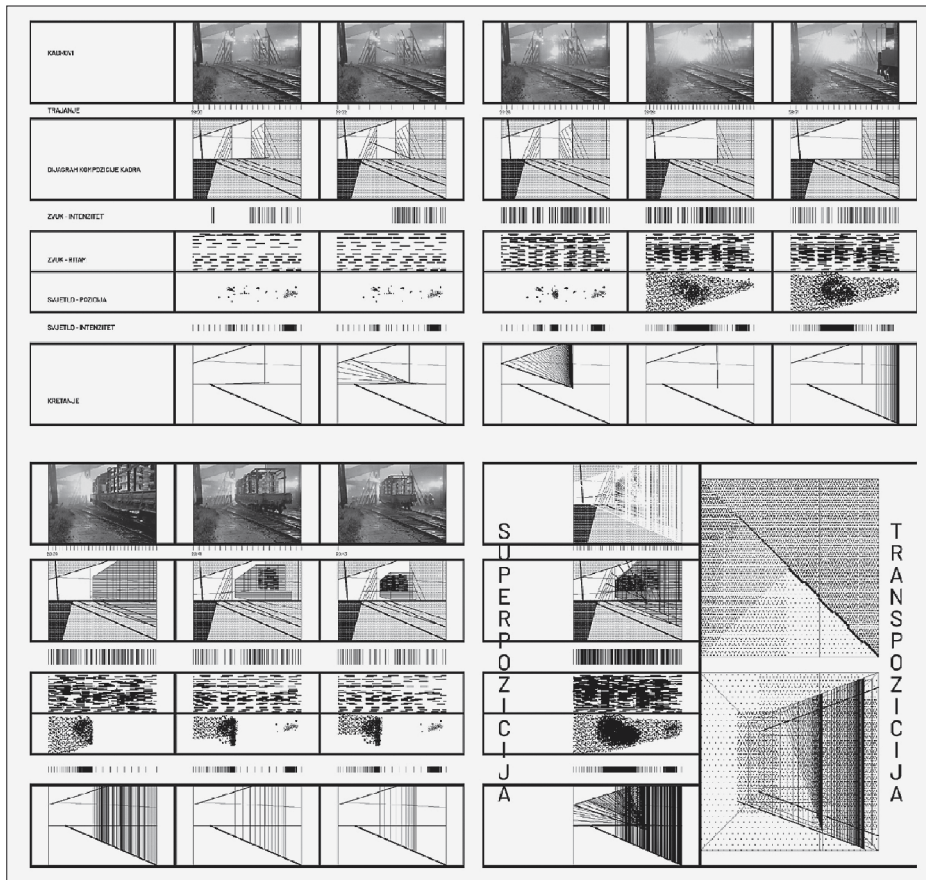


FIG. 8 WORKSHOP *DISPOSITION Dialogue Diagram /Architecture_Film_Dance*, SC GALLERY; FILM CLIP ANALYSIS: A. TARKOVSKY, *STALKER*, 1979

Workshops with architecture students *DISPOSITION Dialogue Diagram /Architecture_Film_Dance* explore movements from space to imagination and vice versa, when imagination constructs the space of dialogue through the concept of merging and superimposing real and imagined time, as well as abstract and real space within processual-compositional models. A phantasm is placed at the center of such a diagram; it fills the central void and establishes an impossible relationship – a suprasensible diagram that connects the seemingly unconnectable – architecture and film.

Contemporary architecture of “action” is defined by a desire for interaction, initiating events, animating space, and concepts.¹² Consequently, the compositional diagram is an abstract machine, where the routine of executing the action is not clearly defined, but rather the diagram creatively participates in its creation.¹³ In this way, by creating programs/workshops in order to suggest cross-references between architecture and film, students are revealing the true processual nature of new architecture and the importance of imagination through concept-diagram drawings.¹⁴

Such specific dispositions in artistic and architectural research not only have representational and organizational significance, but also add, change, and create concepts of new realities.¹⁵

CONCLUSION

For architectural practice, this discussion suggests that designing space extends beyond the configuration of physical form to the orchestration of conditions for multilayered experience – where material presence and the virtual dimension of *atmosphere* continuously intersect. Such an approach repositions architecture as an experiential field in which perception, affect, and temporality productively converge. The application of these concepts in practice can lead to architectures that cultivate moments of suspension, affective resonance, and layered reflection; spaces that do not seek to fully control movement, but instead encourage exploration, introspection, and subjective meaning. In this context, the convergence of Böhme’s notion of *atmosphere*, Deleuze’s concept of the *crystal-image*, and Benjamin’s idea of *perception in distraction* establishes a productive theoretical framework through which architecture can transcend its commonplace functionalist and formalist paradigms, evolving toward the creation of space as an active medium of thought, perception, and becoming.

[Translated by Tanja Vohalski]

¹² According to: Gausa et al., 2003

¹³ According to: Deleuze, Guattari, 1987.

¹⁴ Imagination or nothing: I. Tutek, M. Kopic and S. Habjan, 2024: 180-197

¹⁵ According to: Bogalheiro, 2022: 33-38.

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ILLUSTRATION SOURCES

- FIG. 1 Authors, December 17, 2025
 FIG. 2 Courtesy of the author
 FIGS. 3, 4 Authors
 FIG. 5 OPPENHEIMER, BRUNO, 2014
 FIGS. 6, 7 Student work: Petra Omazić; mentors: I. Tutek, B. Lukač, S. Habjan
 FIG. 8 Bernarda Lukač and Ivana Tutek

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All authors contributed equally to the work presented in this research paper. Their roles included conceptualization, methodology, formal analysis, investigation, resources, data curation, writing of the original draft, writing – review and editing, visualization, supervision, and project administration. Each author played an integral part in the research process, ensuring the success of the project. All authors have read and agreed to the published version of the manuscript.



FIG. 1 LOCATION OF THE EXPERIMENTAL PLACE WITHIN THE BUILDING

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VISUAL COMFORT AND INDOOR ENVIRONMENTAL QUALITY IN A WORKPLACE SETTING A CASE STUDY IN ANKARA, TÜRKİYE

ÇANKAYA UNIVERSITY, ANKARA, TÜRKİYE

HUMAN-CENTRIC DESIGN

INDOOR ENVIRONMENT

LIGHTING

VISUAL COMFORT

WORKPLACE

Workplaces are occasionally specified in locations where learning environments are placed together, and they are also found in common areas with various functions. Individuals need light, as it is a vital component of modern life that fosters a sense of comfort, health, and well-being. Lighting systems in interior architecture need to be designed according to the function of the space and individual needs. In cases where natural lighting is insufficient, comfortable, healthy, and prosperous places are designed with mixed-use lighting. Factors affecting indoor environmental quality, such as sound, color, and

thermal comfort, should be designed together with lighting. This study aims to investigate the indoor environmental quality parameters of the specified workplace regarding visual comfort. Students voluntarily participated in the study. An experimental space on the first floor of the building, known as the “Common Building” of Çankaya University and serving as a connection point for the faculties, was chosen for the study. This type of research is crucial for ensuring that indoor environmental quality parameters are effectively utilized indoors to enhance human-centric interior design.

INTRODUCTION

Light enables individuals to experience their surroundings; therefore, lighting design is an important element of interior architecture. The way a space looks is determined by its lighting design, which alters as light is manipulated. People can gather visual information about their environment within seconds without tactile exploration. Their reaction to a space – whether sympathetic or antipathetic – is not only due to the sensation of light striking the retina, but also to other sensations that respond associatively during visual processing and significantly shape the form of the visual information. Space and users interact reciprocally. Lighting can impact occupant well-being, comfort, and productivity, and displeasure with lighting can increase operational costs if it leads to redesign or unexpected environmental intervention (Avci, 2022: 24). Boyce (2018) suggests that lighting quality should be evaluated in terms of its impact on outcomes such as visual performance and behaviour, while Veitch and Newsham (1996) define lighting quality more broadly as lighting that supports visual performance, task and behavioural performance, social interactions, mood, health and safety, as well as aesthetic judgments. Both definitions include acknowledging the space's purpose (the functions or activities that occur in a specific context) and the user (the individuals who complete the duties and activities). According to Veitch and Newsham (1998: 98),

individuals can meet all their behavioural needs with adequate lighting. This hypothesis has also the advantage of being quantitative, as it solely addresses the direct effects of bright settings on individuals (Alnajdawi, 2019: 214; Mahbob et al, 2011: 435). Veitch (2012: 255) classifies human needs for lighting quality into six categories: visibility, task performance, social behaviour, health and safety, comfort and mood, and judgments. Good lighting design starts with identifying and resolving visual functions and task-related difficulties. Good lighting may meet human needs in any context. According to Juslén and Tenner (2005: 846), high lighting quality improves performance, visual comfort, and interpersonal interactions. Visual performance improves when people can see the job at hand. Furthermore, by removing conspicuous discomfort, performance would improve due to increased concentration. Similarly, clearer visual contact among individuals enhances interpersonal interaction, resulting in more effective communication and collaboration.

Aside from specified locations such as libraries, workplaces have been changed into spaces where individuals work, socialize, and do other daily activities in educational buildings. Many people spend the majority of their time in workplaces or learning environments like universities, colleges, and schools. The physical environment has an impact on students' behaviour and achievement. Learning environments are essential places where most formal education takes place. Learning environment conditions are crucial to students' health, performance, and behaviour. Many researchers have found that indoor environmental quality parameters (IEQ) affect people's performance whether they are in work, home, or learning environments. This can be true for schools where it has been found that poor indoor environments may reduce students' performance (Fisk, 2000: 2; Mendell et al., 2002: 1435). The issues become more severe and complicated when dealing with students with special needs, those who have been diagnosed with mental health disorders, and who need special attention and treatment. Indoor environmental quality in buildings includes indoor air quality (IAQ), acoustics, thermal comfort, and lighting (Fielding, 2006: 3; Ricciardi and Burratti, 2018: 24; Zuhair et al., 2018: 70). Lighting is crucial for indoor environmental quality in learning environments. Assessments of lighting quality are still subject to discussion in scientific studies.

It is well known that poor environmental quality severely influences individuals, particularly children, who, along with the sick

and elderly, form a vulnerable population. Indoor environmental quality impacts building occupants' satisfaction, well-being, and productivity (Newsham et al., 2009: 142; Singh et al., 2010: 1665). School lighting must be regarded as a critical, essential, and dynamic component of the educational environment (Dunn et al., 1985: 865). Furthermore, various studies have emphasized the impact of school facilities and lighting on students' learning performance in the learning environment (Alnajdawi, 2019: 214; Samani and Samani, 2012: 129). According to Knez and Kers (2000), lighting in educational spaces directly affects students' memory, perceptual performance, and problem-solving abilities. To improve the performance of teachers and students, optimal lighting levels should be provided, together with appropriate natural and artificial light sources. Good lighting in these areas improves performance and encourages people to study more in educational facilities. Several factors should be considered while designing a workplace's lighting. According to Lyons (2001: 3), there is a direct relationship between the physical elements and characteristics of school buildings and educational outcomes. In educational facilities, natural lighting should be used to its full potential. Natural lighting promotes economic and visual comfort, as well as psychological health. Designs should be devised to ensure that as much daylight as possible enters the educational building. Large window surfaces and skylights should be used regularly in educational facility design. Gallery spaces promote visual comfort by extending visual communication across floors, allowing daylight, and improving overall perception and visibility. The artificial lighting system provides a visual condition in places where natural lighting is inadequate or unavailable. Lighting design should also consider the specific illuminance levels required for certain types of activity. Illuminance values established in the standard EN 12464-1 for workplaces in buildings must be maintained to meet visual comfort and performance requirements. The recommended illuminance requirements for educational areas are listed below: Learning environments 300 lx, technical drawing learning environments 750 lx, whiteboards 500 lx, meeting rooms 200 lx, labs 500 lx, conference rooms 500 lx, staircases 150 lx, circulation spaces 100 lx, and entry hall 200 lx. Based on all of this information, a workplace's lighting design should incorporate indoor artificial lighting and daylight to provide a comfortable lighting environment for the individuals. It should include contextual factors such as light requirements based on tasks and working hours, workplace location, orientation, height, occupant

needs and preferences, and natural and artificial lighting availability.

Workplace lighting covers various working environments and tasks, from offices and small workshops to large manufacturing halls, to reading, sketching, writing, and computer applications. Millions of people spend a big portion of their days in an indoor built environment while working. Aside from its effect on visual performance, lighting significantly impacts the environment and the visual impression of the workspace. When properly planned, the entire working environment can be exciting for the individuals working there. Lighting is provided at their jobs to ensure they can complete their tasks efficiently, swiftly, and correctly.

Light has the most visible impact on humans. Vision, one of the most complicated senses, is the primary process through which people perceive their surroundings. The eye and brain interplay produce vision, allowing people to see their bright surroundings. Humans can only see when there is light; otherwise, they cannot. Visual comfort is the level of visual satisfaction the luminous environment provides due to reduced glare and disturbing luminance in the field of view (Gordon, 2015: 330). Available research results documents of the International Commission on Illumination (CIE) specify the following parameters as relevant to indoor visual comfort: glare, veiling reflections, illuminance levels, luminance ratios, and uniformities; colour rendering index (CRI), correlated colour temperature (CCT), flicker, space, and room appearance, surface brightness and colour, the appearance of light and luminaires (Iacomussi et al., 2015: 730).

Some strategies for assessing visual comfort have been tried. The unified glare rating (UGR) is used to assess visual comfort in lighting systems, considering the luminaires' positioning, the structure's proportions, the background reflection indices, and the user's position in an indoor environment (Rossi, 2019: 108). Wilkins and Boyce (2018: 100) discovered that legally enforceable minimum illuminance recommendations substantially exceed what is required to enable reasonable visibility in most countries. Values may differ between countries, depending on the conditions. Wang et al. (2015: 1436) evaluated visual fatigue under six distinct lighting settings, designing two illuminance levels (500 lx, 1000 lx) and three CCT levels (2700 K, 6500 K, and 10000 K). Their findings suggested that the two lighting levels (6500 K, 1000 lx, and 2700 K, 500 lx) caused the least visual fatigue.

The term 'spatial brightness' can be defined as the perceived brightness of humans when

engaged in an environment or viewed from afar. The environment occupies a significant portion of the visual field (Islam et al., 2015: 55). One study found that the spatial power distribution (SPD) of a lighting source influences the perception of spatial brightness, with places illuminated by lighting sources with varying SPDs seeming differently bright at the same illuminance (Fotios, 2001: 170). SPD affects the visual comfort, task performance, energy efficiency, perception of space, health & well-being. The spatial brightness can be defined as dim or bright. Humans feel more at ease in a light indoor environment. Thus, spatial brightness for office lighting relationships is important for subjective indoor environment appraisal.

Avcı (2017: 55) investigated the impact of lighting conditions on visual comfort parameters such as distraction, clarity, fatigue, eye burning, focusing difficulty, and glare in an experimental room. Six lighting settings were tested (LED and OLED illuminance at 200, 500, and 800 lx). In terms of visual distraction, visual clarity, visual fatigue, burning eye, and focusing problems, OLED lighting results showed that the illuminance level of 500 lx was somewhat more comfortable than the other illuminance levels. According to Avcı and Akbay (2022: 137), OLED displays with a glare intensity of 200 lx are marginally more comfortable for work performance. These findings revealed that the visual comfort requirements differed depending on the lighting conditions and illuminance levels.

METHODOLOGY

PARTICIPANTS

The experiment was carried out with the participation of 46 voluntary students. The participant group for the study consisted of 26 females, 19 males, and 1 participant of this sex. They were undergraduate students from different departments and faculties at Çankaya University in Ankara, Türkiye. The participants from different departments use the selected workplace together. Their ages range from 20 to 39, with a mean age of 22.18. They were informed about the research and asked whether they would participate in the survey. All the participants who were given information about the study willingly agreed to answer the survey questions. They were from different departments: interior architecture, civil engineering, software engineering, computer engineering, electrics and electronics engineering, industrial engineering, translation and interpreting studies (English), psychology, public relations and advertising, and management information systems. 10 from the department of interior architecture,

one from the department of civil engineering, one from the department of software engineering, 12 from the department of computer engineering, four from the department of electrics and electronics engineering, one from the department of electrics and industrial engineering, two from the department of translation and interpreting studies (English), 12 from the department of psychology, one from the department of public relations and advertising, and two from the department of management information systems. Most participants had no prior knowledge or experience in interior design, including interior design notions and an understanding of the effects of indoor environmental qualities in indoor environments. This increased awareness of the selected workplace regarding indoor environmental quality parameters.

EXPERIMENTAL PLACE

The experiment occurred in an 80 m² workplace at the Common Building, Çankaya University, Ankara, Türkiye. It was on the first floor. The workplace was in an atrium from which the two floors above it were visible and was located between two staircases. Six working tables (80×160×110 cm) were perpendicular to the cylindrical columns, with eight height-adjustable bar seats per working table. The second floor's exterior featured 34 frosted windows (17 on the left and 17 on the right) and 19 transparent windows. The third-floor facade featured composite panels and fabric coverings for the railing, and cylindrical columns were seen. The atrium benefited from natural lighting through eight triangular openings in the roof. Fig. 1 shows the location of the experimental place within the building.

The Natural Color System (NCS) was adopted as the colour standard, and the corresponding NCS notations were obtained using the NCS Colour Scan 2.0 colour measurement device. This device also defined coloured surfaces such as walls, floors, carpets, furniture, and textiles in the interiors. Table I presents the list of surfaces along with their NCS notations.

EXPERIMENTAL INSTRUMENTS AND PROCEDURE

This study has undertaken a comprehensive experimental and theoretical investigation into indoor environmental quality (IEQ), particularly emphasizing visual comfort in a multi-functional university workplace setting. By integrating objective environmental measurements with user-based survey responses, the research provides insights into the interplay between lighting conditions and

human comfort in shared indoor environments. This study was prepared with the approval of the Çankaya University Science and Engineering Sciences Scientific Research and Publication Ethics Committee dated 22.01.2024 and numbered E-41645618-050-146205. Indoor environmental quality parameters, such as indoor air temperature, gases (CO₂), sound, etc., directly impact visual comfort. These indoor environmental quality parameters had to be controlled, otherwise differences in conditions had a negative impact on the participants' physical and psychological attitudes. The following lighting and measuring instruments were used throughout the experiment: i) indoor air temperature (Non-contact thermometer, 'Testo 174 T'); ii) sound level (Decibel meter, 'Testo 815'); iii) VOC levels (Detector, 'Toxi RAE Pro Pid'); and iv) Luminance Meter, 'Konica Minolta CL-70F'. These instruments collected information about the participants and the workplace during the procedure.

The experiment was carried out with the participation of 46 student volunteers and occurred in a workplace at the Common Building, Çankaya University, Ankara, Türkiye. The 'Lighting Conditions Survey' and 'Office Lighting Survey' evaluated general lighting conditions and indoor environmental quality parameters in the immediate surroundings. The questions in these tests were reduced to 10 questions and shaped in line with the scope of the study. Questions 1 and 5 aim to obtain demographic information, while questions 6 to 10 cover task lighting usage, evaluation of indoor environment quality parameters, assessment of general lighting conditions based on visual comfort criteria, and questions related to the daily purposes and usage duration of the selected work area. The questions seven and eight had a 5-point Likert scale. There were six tables in the experimental place and participants were required to sit at any of the six tables. There was no variation in environmental quality parameters across all desks in the work environment. After that, the lighting materials, devices, and measurements (CO₂ concentration, indoor air temperature, core body temperature, and sound), and questionnaires were explained. Data were collected from August 1 to August 15, 2024. Since outdoor weather conditions vary throughout the year; all results are limited to this period. Maximum daytime temperatures ranged from approximately 31-35 °C. Illuminance levels measured on 16 points of 8 table surfaces varied between 320-580 lx. Participants progressed through all stages at their own speed, with session durations averaging around 10 minutes and varying between 5 and 15 minutes.

TABLE I THE SURFACES, ALONG WITH THEIR NCS NOTATIONS

Surface	Material	NCS Notation	Color
Floor	Epoxy	S 5005-G8oY	
Wall	Paint	S 6005-Y8oR	
Cylinder Column	Paint	S 2002-B	
Stair Well	Paint	S 1070-Y1oR	
Working Table	Laminated MDF	S 8000-N	
Bar Chair (Sitting)	Artificial Leather	S 3030-Y4oR	
Bar Chair (Skeleton)	Plywood	S 9000-N	

They left the workplace after completing the process.

LIMITATIONS

Despite the methodological rigor employed in this study, several limitations should be acknowledged. First, the sample size was relatively small (N = 46) and consisted solely of undergraduate students from a single university. Although the participants represented a variety of academic departments, the sample may not fully reflect the broader population of workplace users, thereby limiting the generalizability of the findings to other age groups, professional contexts, or cultural settings. Second, the study was conducted within a single workplace environment located in the Common Building at Çankaya University. The architectural characteristics, interior layout, colour scheme, and lighting configuration of this specific space may differ substantially from other university or office environments. As a result, the conclusions drawn from this particular setting may not fully extend to workplaces with different spatial or environmental characteristics. Third, although objective measurements were taken for several indoor environmental quality parameters (CO₂ concentration, air temperature, sound level, VOCs, and luminance), the study relied on self-reported survey responses to assess participants' perceptions of lighting quality and visual comfort. Self-reported data are inherently subject to biases such as social desirability, recall limitations, and individual differences in perceptual sensitivity. Fourth, the experiment employed a cross-sectional design in which participants completed the surveys in a single session lasting 5-15 minutes. This design does not allow for the assessment of changes in visual comfort perception over time or under varying lighting scenarios. Participants were also

TABLE II LIGHTING CONDITIONS SURVEY (SAMPLE GROUPS)				TABLE III OFFICE LIGHTING SURVEY (GENDER GROUPS)			
Independent Samples t-Test				Independent Samples t-Test			
Parameter	t	df	p	Visual Comfort Criterion	t	df	p
Natural Lighting	.998	43	.324	Visual Distraction	-.910	43	.368
	-.954	31.924	.347		-.915	39.764	.366
Noise Level	-.146	43	.885	Visual Clarity	.198	43	.844
	-.142	34.786	.888		.190	32.548	.850
Odor	-1.061	43	.295	Visual Fatigue	-.771	43	.445
	-1.053	37.771	.299		-.769	38.530	.447
Ventilation	-1.276	43	.209	Eye Burning	.764	43	.449
	-1.317	42.392	.195		.771	40.116	.445
Air Temperature	-3.115	43	.003	Focusing Problem	.355	43	.725
	-3.138	39.944	.003		.363	41.834	.718
General Environment	-2.524	43	.015	Glare	.394	43	.695
	-2.479	36.237	.018		.394	38.922	.695

allowed to choose any of the six available tables, which, although consistent in IEQ conditions, may introduce minimal, uncontrolled micro-variations in perceived comfort. Finally, most participants had limited prior knowledge of interior design concepts and indoor environmental quality parameters. While this may reduce expectation bias, it may also constrain their ability to articulate nuanced evaluations of lighting conditions, potentially affecting the depth of perceptual data. Future research could address these limitations by incorporating larger and more diverse samples, examining multiple workplace environments with varying architectural and lighting characteristics, conducting longitudinal or seasonal comparisons, and integrating additional objective visual performance measures to complement subjective evaluations.

RESULTS AND DISCUSSION

IBM SPSS Statistics 23.0 software was used to assess data normality. Mean and standard deviation statistics were used to make observations about the distribution of the items. Normality can be determined to some extent by calculating skewness and kurtosis values. The skewness and kurtosis values (between -1.5 and +1.5) of the questionnaires generated by the scale scores were deemed adequate for a normal distribution. The analysis was conducted using parametric approaches. An independent samples t-test was used to evaluate the sample groups using the Lighting Conditions Survey and Office Lighting Survey based on the experimental place's indoor environmental quality parameters. Bivariate Correlation Analysis was applied to investigate the relationship between the nat-

ural lighting conditions and visual comfort criteria, natural lighting, and the relationship between indoor environmental quality parameters. When conducting this test, visual comfort criteria were evaluated based on the lighting conditions in the experimental place. It was also found that 42 participants used their right hand and 4 used their left hand; 27 participants wore glasses or contact lenses; and 22 used task lighting to do daily activities in their home. It was also determined that 16 participants used the experimental place for less than 30 minutes per week, 18 used it for 1-2 hours per week, and 12 used it for more than 2 hours per week.

Accordingly, the differences between genders and the indoor quality parameters of the part of the Lighting Conditions Survey were analysed within the scope of the study. The results of an independent samples t-test indicated statistically significant differences between the groups for indoor air temperature ($t(43) = -3.115, p = 0.003$) and general environment features ($t(43) = -2.524, p = 0.015$). According to the mean values, female participants found the experimental place more satisfying than males for these parameters. Table II presents the statistical results. The differences between genders and the visual comfort criteria were also analysed using the same test. The results indicated that there were no statistically significant differences between the sample groups and the visual comfort criteria. The lack of difference between genders was interpreted as the participants having the same age range. It was also said that the experimental place provided visual comfort conditions for the students, and the lighting conditions were sufficient. Table III presents the statistical results.

Bivariate Correlation Analysis was applied to investigate the relationship between the natural lighting conditions, spending time in the experimental place, and visual comfort criteria. The positive correlations were identified between specific questions and the visual comfort criteria. When the correlations between visual comfort criteria were examined, visual distraction had positive correlations with visual fatigue ($r = 0.304^*, p = 0.040$), eye burning ($r = 0.524^{**}, p = 0.000$), focusing problem ($r = 0.572^{**}, p = 0.000$), and glare ($r = 0.410^{**}, p = 0.005$). The criterion of visual fatigue had correlations between eye burning ($r = 0.400^{**}, p = 0.006$) and focusing problem ($r = 0.292^*, p = 0.049$). There was also a positive correlation between eye burning and focusing problem criteria ($r = 0.387^{**}, p = 0.008$). When the visual comfort criteria were analysed with one another, no correlation was observed between focusing and the other comfort criteria. Aside from this finding, the interrelations among the remaining criteria

suggest that the lighting conditions in the experimental setting were assessed using a holistic approach. However, the relationship between spending time in the experimental place and visual comfort criteria was investigated. Statistical data revealed a moderate correlation between spending time and visual distraction ($r = 0.582^{**}$, $p = 0.000$). This relationship is considered significant. A correlation between spending time, focusing problem ($r = 0.369^*$, $p = 0.012$), and glare ($r = 0.328^*$, $p = 0.026$) was also found. As the duration of time spent in an environment increases, attention tends to become more distracted, highlighting the importance of interior design in maintaining visual comfort and sustained focus. Consequently, achieving a visually balanced environment that avoids monotony and overstimulation is essential, particularly in working, studying, or waiting environments. Table IV presents these statistical results. The relationship between indoor environmental quality parameters were also investigated with the bivariate correlation analysis. Results indicated that there was a correlation between the general environment and natural lighting conditions of the experimental place ($r = 0.292^*$, $p = 0.049$), and temperature ($r = 0.305^*$, $p = 0.039$). Table V shows these statistical results.

Visual comfort is one of the critical factors in overall satisfaction with the indoor environment in workplaces. This study aimed to evaluate the effectiveness of various factors for investigating the overall visual comfort at the Common Building, Çankaya University, Ankara, Türkiye. Findings from the independent samples t-test revealed statistically significant gender-based differences in the perception of indoor air temperature and general environmental features, with female participants rating the environment more positively. However, no significant differences were found between genders concerning visual comfort criteria, suggesting that shared characteristics among participants – such as age and academic context – may have homogenized perceptions of lighting quality. These findings also support the conclusion that the experimental workplace successfully met general visual comfort standards for both male and female users. Further, bivariate correlation analysis highlighted meaningful relationships between various dimensions of visual discomfort. Notably, visual distraction was significantly correlated with visual fatigue, eye burning, focusing problems, and glare, indicating that these interconnected symptoms can emerge and impact user performance even in generally well-lit environments.

The correlation coefficients between seven visual comfort criteria are not zero. The relationships are significant, which indicates a sub-

TABLE IV APPLIED TEST RESULTS FOR VISUAL COMFORT CRITERIA AND SPENDING TIME (BIVARIATE CORRELATION ANALYSIS)

Bivariate Correlation Analysis – Visual Comfort Criteria / Spending Time								
		Visual Distraction	Visual Clarity	Visual Fatigue	Eye Burning	Focusing Problem	Glare	Spending Time
Visual Distraction	Pearson r	1	.275	.304 [*]	.524 ^{**}	.572 ^{**}	.410 ^{**}	.582 ^{**}
	p		.065	.040	.000	.000	.005	.000
	n	46	46	46	46	46	46	46
Visual Clarity	Pearson r	.275	1	.128	.180	.211	.191	.085
	p	.065		.395	.232	.159	.203	.574
	n	46	46	46	46	46	46	46
Visual Fatigue	Pearson r	.304 [*]	.128	1	.400 ^{**}	.292 [*]	.112	.089
	p	.040	.395		.006	.049	.460	.557
	n	46	46	46	46	46	46	46
Eye Burning	Pearson r	.524 ^{**}	.180	.400 ^{**}	1	.387 ^{**}	.232	.279
	p	.000	.232	.006		.008	.121	.060
	n	46	46	46	46	46	46	46
Focusing Problem	Pearson r	.572 ^{**}	.211	.292 [*]	.387 ^{**}	1	.203	.369 [*]
	p	.000	.159	.049	.008		.177	.012
	n	46	46	46	46	46	46	46
Glare	Pearson r	.410 ^{**}	.191	.112	.232	.203	1	.328 [*]
	p	.005	.203	.460	.121	.177		.026
	n	46	46	46	46	46	46	46
Spending Time	Pearson r	.582 ^{**}	.085	.089	.279	.369 [*]	.328 [*]	1
	p	.000	.574	.557	.060	.012	.026	
	n	46	46	46	46	46	46	46

* Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed)

TABLE V APPLIED TEST RESULTS FOR INDOOR ENVIRONMENTAL QUALITY PARAMETERS (BIVARIATE CORRELATION ANALYSIS)

Bivariate Correlation Analysis – Indoor Environmental Quality Parameters							
		Natural Lighting	Noise Level	Odor	Ventilation	Temperature	General Environment
Natural Lighting	Pearson r	1	.178	-.006	-.044	.147	.292 [*]
	p		.236	.969	.770	.331	.049
	n	46	46	46	46	46	46
Noise Level	Pearson r	.178	1	.109	-.064	.163	.163
	p	.236		.472	.674	.279	.279
	n	46	46	46	46	46	46
Odour	Pearson r	-.006	.109	1	.592 ^{**}	.271	.258
	p	.969	.472		.000	.069	.083
	n	46	46	46	46	46	46
Ventilation	Pearson r	-.044	-.064	.592 ^{**}	1	.308 [*]	-.096
	p	.770	.674	.000		.037	.524
	n	46	46	46	46	46	46
Temperature	Pearson r	.147	.163	.271	.308 [*]	1	.305 [*]
	p	.331	.279	.069	.037		.039
	n	46	46	46	46	46	46
General Environment	Pearson r	.292 [*]	.163	.258	-.096	.305 [*]	1
	p	.049	.279	.083	.524	.039	
	n	46	46	46	46	46	46

* Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed)

stantial direct effect of them on the student's visual comfort. These findings align with previous studies (Kwong, 2020: 8; Noda et al., 2020: 8; Abboushi et al., 2021: 332). IEQ has been discovered to both promote and hinder user's comfort, performance, and contentment with their physical environments, and hence can help achieve environmental and economic goals for sustainable building. The building's contributions to the biological basis of user comfort, health, and well-being are appropriate indoor environmental factors such as light, air, temperature, sound, visible and physical space, and users' ability to personally manage these (Choi et al., 2014: 2).

CONCLUSION

This research carried out a broad experimental and theoretical analysis of indoor environmental quality (IEQ), focusing particularly on visual comfort within a multifunctional university workplace. Through the combination of objective environmental data and user survey feedback, the study sheds light on how lighting conditions interact with human comfort in shared indoor built environment. This study contributes to the literature by empirically validating a multidimensional IEQ framework in a higher-education context, demonstrating that perceived environmental quality mediates the relationship between physical design inputs and learning-related satisfaction outcomes. Nonetheless, future research employing objective performance indicators (e.g., cognitive tests, academic achievement, physiological measures) and longitudinal experimental designs would strengthen causal inference and further advance evidence-based sustainable learning-environment design. However, the application of such studies to large and different groups is of great importance for other studies that may appear in the literature. In addition, this study reinforces the critical role of well-balanced lighting design in enhancing occupant comfort and productivity. It also underscores the importance of concurrently evaluating multiple indoor environmental quality parameters rather than in isolation when designing human-centric indoor environments. This research's empirical evidence and user feedback may inform future lighting strategies in educational and professional settings, particularly in multi-use or transitional zones. Expanding this study to include diverse user profiles, time-of-day variations, and dynamic lighting systems could offer deeper insights into optimizing visual comfort across varied interior contexts.

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CONTRIBUTION

Conceptualization, A.N.A.; methodology, A.N.A.; software, A.N.A.; validation, A.N.A.; formal analysis, A.N.A.; investigation, A.N.A.; resources, A.N.A.; data curation, A.N.A.; writing—original draft preparation, A.N.A.; writing—review and editing, A.N.A.; visualization, A.N.A.; supervision, A.N.A.; project administration, A.N.A.; funding acquisition, A.N.A. Author has read and agreed to the published version of the manuscript.

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BOOK REVIEWS

SUMMARIES OF
DOCTORAL DISSERTATIONS

SANJA GAŠPAROVIĆ

A VISION OF A FUTURE CITY: THE HORIZON 2050 A GLIMPSE INTO THE FUTURE

VIZIJA GRADA U BUDUĆNOSTI:
HORIZONT 2050.
BUDUĆNOST KOJA SE TEK NAZIRE



University of Zagreb Faculty of Architecture, 2025

Specialized texts or supplements: T. Čerina, V. Sonje, S. Stanić, K. Borovec, A. Mrda, I. Čizmek, M. Tadić, B. Buden, S. Gašparović, M. Vedriš, I. Tkalcic, A. Kostrenčić, L. Mršić
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The publication “A Vision of a Future City: THE HORIZON 2050” authored by project leader and editor-in-chief emeritus Prof. Dr. Tihomir Jukić from the Department of Urbanism, Spatial Planning and Landscape Architecture (KUPPPA) at the Faculty of Architecture, Zagreb University, was published in 2025 with the editorial collaboration of Kristina Perković and Mateja Nosil Mešić.

This work presents the results of several years of research driven by the desire to better understand the dynamics of urban transformation – its causes, trajectories, and the possibilities for shaping desirable urban futures. It begins with a critique of unimaginative and fragmented approaches to contemporary urban challenges in today’s unstable political, social, and economic circumstances at the city, state, and European levels.

The research highlights concepts and models relevant for future-oriented urban planning. By examining examples of good practice, long-term planning concepts in European cities, and influential documents and charters, the author aims to stimulate interdisciplinary dialogue that can support the development of visions for Zagreb and other Croatian cities.

The publication integrates the outcomes from the courses *Workshop 3 – Urbanism and Research Seminar*, conducted between 2016 and 2022. Therefore, a special value of the book stems from the contributions of forty students who, over several generations, participated in developing its content as part of their seminar and research projects under the mentorship of Prof. Jukić.

The publication created in collaboration with students testifies to the successful outcomes of teaching innovative courses, significantly marked by a research-based approach that has improved and modernised the teaching of urbanism. Through this approach, students critically examined European strategies and city development plans, learning how to select context-appropriate models based on the specific characteristics, needs, and heritage of each city, while also responding to global trends and challenges.

The research behind the publication was further supported by the scientific project *Sustainable Models of Regeneration in Contemporary Strategies of European Cities* (2023-2024), conducted at the Faculty of Architecture. Its objective – to understand urban processes and anticipate desirable development models – aligns with the core themes of the publication. Taken together, the findings from both teaching and scientific research underscore the importance of long-term, integrated, interdisciplinary, and inclusive planning.

The publication *Horizon 2050* is conceived as a three-fold view of the city of the future, and can be approached on several levels:

- It opens an interdisciplinary perspective through a series of shorter essays by invited authors from fields ranging from urbanism and sociology to economics and technology, demonstrating that the city of the future should and must be viewed in a broader social and cultural context.

- It offers an overview of contemporary trends through a selection of current concepts and approaches to city planning, thereby serving as a valuable resource for students, researchers, and professionals. It presents examples of good practice from European cities that are already embodying forward-looking visions through strategic planning.

Thus, the publication extends beyond the academic sphere, becoming a tool for shaping public policies and encouraging a broader societal debate. It reminds us that planning the future city is not merely a technical task but a cultural and ethical responsibility – an expression of the kind of society we aspire to become. The book is intended for professionals, scholars, and students in architecture, urbanism, spatial planning, and landscape architects, as well as the wider public. It is structured into six methodologically coherent chapters:

The first chapter, *Good Cities / Better Life*, provides an introductory review by Prof. Jukić on the topic, motivation and objectives of the research, as well as the results achieved.

The second chapter, *Contemporary Tendencies of Cities*, analyses various conceptual approaches to strategic city planning that, by focusing on individual aspects of sustainability, strive to achieve healthier, greener, safer and more liveable cities.

The third chapter, *City & ...*, offers an overview of the most important urban functions through concepts of future development. It examines housing – with particular emphasis on affordable housing – followed by the economy, the role of public spaces and social standards, and the relationship between rural and urban space, tourism and leisure.

The fourth chapter, *The City – Charters, Declarations, Agendas*, reviews key documents that situate city planning within the context of climate change, demographic challenges, and economic transformation, providing essential principles for planning and managing cities.

The fifth chapter, *Visions of City Development by 2050*, analyses seventeen European cities and the concepts underpinning their development.

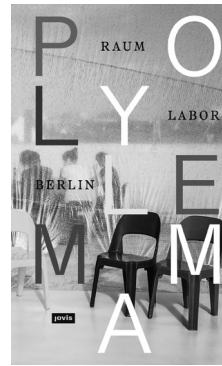
The sixth chapter, *The Desirable Future of Zagreb*, presents guidelines for the city’s future development, addressing both individual areas and thematic units.

Each chapter is accompanied by an Appendix – a contribution to the discussion of visions of the city by experts in various fields, including economics, sociology, philosophy, landscape and ecological sustainability, AI and city management, tourism, architecture, and urbanism. In this way, the publication underscores one of the fundamental premises of successful future-oriented urban planning: the necessity of an interdisciplinary approach.

Systematically collected, analysed, and commented research materials represent a significant contribution to methods of teaching urbanism, serve as an incentive for essential professional discussions, and provide an important starting point for future interdisciplinary approaches to scientific research on the phenomenon of the contemporary city.

TAJANA JAKLENEC

RAUMLABORBERLIN: POLYLEMMA



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 Editor: raumlaborberlin
 Design Bonbon, Zurich

480 pages, 620 illustrations (colour and b/w)
 [28.5/21.5 cm, softcover]

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When Nishat Awan, Tatjana Schneider, and Jeremy Till tried to synthesise the landscape of spatial activism agencies in 2011 – first as a web database, later as the book *Spatial Agency: Other Ways of Doing Architecture*, published by Routledge – we confirmed the uniqueness of *raumlaborberlin*'s practice, highlighting its influence on contemporary spatial activism and experimental urbanism. Schneider and Till presented *raumlaborberlin* as a group of Berlin-based architects who came together in 1999 in response to rapid and unrestrained city development following the fall of the Berlin Wall. *raumlaborberlin* is understood as a space laboratory – an interdisciplinary initiative wherein architecture serves as a pivotal instrument. Working between architecture and public art, they create projects based on events, performance, and theatre. Collaboration is central: engineers, sociologists, ethnographers, local experts, and citizens contribute. Their work is politically motivated, aiming to influence decision-making within governments, academia, or other institutions. Projects addressing social relations often challenge existing norms and private claims, producing lasting interventions. Their practice is simultaneously experimental, pedagogical, and socially engaged, revealing multiple layers of urban potential.

They do not see their profession as problem-solving, but as creating productive problems. Placing themselves in the utopian tradition of the 1960s, particularly Yona Friedman, Buckminster Fuller, and Haus-Rucker-Co, *raumlaborberlin* anticipated experimental and reversible architecture also practised by Urban Catalyst and Exyzt. Their projects transform urban landscapes through “urban prototypes” – temporary interventions such as pneumatic structures or submarines from waste materials. Residents are directly involved in shaping their neighbourhoods. Notable projects include *Working on Common Ground* (2022, Pristina), *Floating University* (2018, Berlin), and *Allmänna Badet* (since 2014, Gothenburg). Their Venice Biennale contribution, *Instances of Urban Practice* (2021), earned the Golden Lion.

Nearly fifteen years after *Spatial Agency*, *raumlaborberlin* released its first monograph, *Poly-*

lemma, awarded the DAM Architecture Book Award in 2024. Although *Polylemma* (Greek poly = many; lemma = assumption or proposition) denotes a situation with more than two – often difficult or undesirable – options, the same cannot be said for *raumlaborberlin*'s practice. They may have had to choose the lesser evil, yet each time emerged richer through experience. The book presents the collective's work: nine members revisit sites, meet colleagues and critics, dissect processes, and reflect on tools and methods. Topics include strategies for collective learning, experimental building, and radical recycling. Their discourse unfolds through exhibitions, lectures, workshops, publications, and radio.

The book resists conventional structure: it lacks chapters or standard contents. Instead, it presents projects and texts with thematic anchor points such as action-oriented practice, experimental building, spaces of encounter, and recycling. Materials are organised as bookwalks, conversations, footnotes, project recipes, archive texts, and commentary by theorist Christopher Dell, guiding readers. The book's design, realised by the studio Bonbon, reflects its playful, experimental, and heterogeneous content, enhancing engagement. All of this can be found in the introductory compass, a navigational guide that helps readers approach the heterogeneous material. Like a city with many entrances and exits, the book can be read non-linearly. Specific projects are presented as stories, experiments, or recipes, reflecting the collective's iterative approach. *Polylemma* challenges us to expand our notion of space and serves as a plea for the city as a sphere of action. This heterogeneity mirrors *raumlaborberlin*'s engagement with cities, materials, and communities – always context-sensitive, socially embedded, and responsive to urban complexity.

At the same time, this work benefits from a more explicit thematic grouping – or a network analysis – to clarify interrelations between methods, collaborators, and sites without diminishing the experimental spirit.

Living with the climate emergency demands systemic change with deep implications for how we produce and inhabit space. *Architec-*

ture after Architecture – Spatial Practice in the Face of Climate Breakdown (2021-2024) examines how spatial practices address the cultural and socioeconomic conditions shaping architectural action. *raumlaborberlin*'s *Floating University* features as a key case study, exemplifying experimental, socially engaged, and climate-responsive practice, aligning with Schneider's initiative *Architecture is Climate: Reconstructing the Curriculum*. The publication of *Polylemma* is therefore especially timely, offering insight into the forms of spatial practice these projects identify as crucial in a climate-critical era.

The *Floating University* project remains a key illustration of *raumlaborberlin*'s approach: a self-organised space transforming transitional sites into platforms for engagement and collective imagination. Beyond physical interventions, the *Floating University* serves as a platform for discourse, workshops, and pedagogical experiments, where ideas about urbanism, climate, and social responsibility are explored. Their use of recycled materials complements interventions, functioning as a practical, political, and conceptual tool rather than only an aesthetic gesture.

For a quarter of a century, *raumlaborberlin* has pioneered new spaces for action, charting unique paths in cooperative urban development and creating places to foster encounters. Together with experts across various fields, they explore forms of urban practice, participation, and the joint production of space. Architecture is understood not as an object, but as a layer of history and a tool for creating cities of possibility – a city of tomorrow.

In conclusion, *Polylemma* is more than a monograph: it embodies a philosophy of practice. *raumlaborberlin* demonstrates how experimental, collaborative, and context-sensitive architecture responds to contemporary challenges. As architectural culture faces social, ecological, and disciplinary turbulence, their approach remains relevant and necessary. Their methods can move beyond activism into mainstream practice, offering a model for future architectural action that merges experimentation with social and environmental responsibility.

ZORANA PROTIĆ

HETEROGENEOUS CONSTRUCTIONS STUDIES IN MIXED MATERIAL ARCHITECTURE



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Project Leads: Aaron Forrest, Brett Schneider, Yasmin Vobis
Graphic Design: Andrew LeClair
Prototypes Photography: Naho Kubota

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Heterogeneous Constructions can be read as a manifesto opposing established building norms, advocating an open, flexible framework of heterogeneity that embraces the rawness and imperfection of architectural appearance. This research introduces the idea of offering a new perspective on the heterogeneity of construction, in which each material constitutes an inseparable segment of the whole, with multiple roles in relation to other materials and to the system as a unified entity. A collage of several different materials has a greater impact than the sum of individual characteristics of each material on its own. At the same time, the material becomes an inseparable component of the structure, acting as the building's envelope while simultaneously asserting itself as the aesthetic identity of the whole.

The idea for this thesis on the heterogeneity of structure emerged as a response to the homogeneous approach to constructing layered systems, whereby each layer plays a distinct role within the whole. The monofunctionality of each structural layer dates back to the twentieth century, taking the form of structural and aesthetic paradigms that dominated practice and had a profound impact on architectural discourse. On the surface, the final layer of the construction does not reveal anything about the structure it encloses; rather, it conceals it, creating a fictional image of the building. As a result, contextual conditions and cultural differences are overlooked, leading to problematic uniformity and regulation. In this approach, houses – despite being located in geographically and climatically diverse regions – are built according to identical construction standards and conventional notions of uniformity.

The research is structured around three methodological approaches: analysis, essay, and prototyping. Two key chapters form the backbone of this study: one provides an analysis of relevant case studies, while the other details the implementation of full-scale structural prototypes, developed by students from UC Berkeley, the Harvard Graduate School of Design, and the Rhode Island School of Design. These efforts directly contribute to the

study's overarching objectives. The fifteen selected examples of heterogeneous constructions span a wide historical range, from Mesopotamian and vernacular architecture to the Industrial Revolution and contemporary experimental practices. They are typologically diverse, encompassing residential, social, and industrial structures.

All case studies were analysed and catalogued with basic data on location, purpose, and construction date, along with a representative photograph and a concise explanation of their heterogeneity. What makes this analysis particularly valuable is the use of analytical drawings, in which each material group is assigned a distinct colour. Each structure is represented through three linear drawings, as well as 2D and mathematically precise axonometric projections. This part of the research resulted in the identification of six categories of structures, classified by materials and construction types: *Stacks, Sandwiches, Fills, Wraps, Collages, and Scaffolds*.

The second part of the research involved hands-on work with an experimental model that collages simple, readily available consumer construction materials into spatial installations, each illustrating the logic behind one of the six material groups. The goal of this practical work is not to construct fully realized static models of columns, walls, or ceilings, but to explore the fundamental principles that govern the connections between different materials and elements in creating stable structures. In this way, the combination of drawings and the immediacy of building materials in dialogue serves as a key didactic tool for both theoretical and empirical investigations into how systems operate and how individual elements interact.

The very titles of the critical in-depth essays – *Making Do, Category Errors, The Difficult Imperfect Whole, Mixed Media, Grid, Machine, Mud, Work, Air, and How to Build Heterogeneously* – reflect the breadth of this research in interpreting heterogeneity. The authors, all of whom, in addition to their practical work, teach at one of the three aforementioned schools, highlight several key experimental models of heterogeneity:

19th-century constructions such as the Manier Chocolate Factory in France (1871-1872); 20th-century modernism, exemplified by Mies van der Rohe's Barcelona Pavilion (1929); and contemporary 21st-century design practices, represented by Belgian architects Jan De Vyllder and Inge Vinck, and Swiss architect Roger Boltshauser.

These essays explore heterogeneity from multiple perspectives: material, structural, formal, cultural, economic, and ecological. Heterogeneous constructions present an unconventional approach in which the act of construction becomes an inseparable part of the design process itself. This approach embodies what might be termed "Inventive Pragmatism". No single material can fully satisfy all requirements. All materials, whether organic or artificial, inevitably wear out, age, and deteriorate over time. In terms of materials, only the amount absolutely necessary is used.

All processes are considered acceptable, from reconstruction and redefinition to the construction of entirely new buildings. The heterogeneous approach integrates established construction practices with contemporary technologies, utilizing available materials while adhering to construction norms and standards. However, standard procedures and static calculations do not apply to these structures. Despite this, they continue to be determined, verified, and empirically proven, as they have been throughout history. Ultimately, the beauty of these buildings lies precisely in their incompleteness and imperfections.

The book makes a substantial contribution to the advancement of both architectural theory and professional practice. One of its key messages is that practicing architects must rethink and innovate construction, becoming more actively engaged in the building process itself. Architecture, in this context, should be viewed as a permanently open process. At the same time, the academic community must foster open discourse on heterogeneity, preparing for a different and better world.

TAJANA JAKLENEC

ARCHITECTURE FOLLOWS CLIMATE TRADITIONAL ARCHITECTURE IN THE FIVE CLIMATE ZONES

ARHITEKTURA SLIJEDI KLIMU
TRADICIONALNA ARHITEKTURA
U PET KLIMATSKIH ZONA

ALEKSANDROS IOANNOU-NAOUM



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bibliography, 297 illustrations (colour and b/w),
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Climate-neutral, energy-efficient, and circular building design is an area of expertise for Alexandros V. E. Ioannou-Naoum, a research associate at TU Wien and the Institute of High-Rise and Industrial Construction. He develops solutions to reduce resource usage, CO₂ emissions, and energy consumption with an emphasis on sustainable enhancement and smart technologies like artificial intelligence and machine learning.

His first book, *Architecture Follows Climate – Traditional Architecture in the Five Climate Zones*, structured according to five climate zones (tropical, arid, temperate, continental, polar), explores traditional architecture through the lens of climatic conditions. The focus of this research endeavour is to point out traditional vernacular techniques across all five climate zones. These techniques have enabled humans to live or survive in extreme climatic conditions by recognising, understanding, and using the natural energies and materials that are specific to their surroundings. Although traditional architectures are often attributed to past and outdated societies, they embody the common heritage of architectural knowledge that has been accumulated, tested and continuously developed over generations.

However, Ioannou-Naoum is not alone in this line of thought. Bernard Rudofsky and Viktor Papanek worked in different fields – the former in architecture and the latter in industrial design – their perspectives converged in their critique of the modernist, technologically dependent approach to building and design. In 1964, in *Architecture Without Architects* Rudofsky emphasised the value of vernacular architecture, shaped by collective experience, in harmony with natural conditions, and without reliance on industrial infrastructure.

In his pamphlet *Form Follows Climate* (1967), Charles Correa redefined the well-known modernist principle form follows function into a new maxim, emphasising climate-responsive architectural form. Correa argued that architecture cannot be universal but must derive from local climatic, cultural, and social conditions. For him, a building's form – its section, plan, orientation, and mass – is

not an aesthetic decision but a response to the sun, wind, humidity, and temperature.

A few years later, in *Design for the Real World* (1971), Papanek voiced a similar concern in the field of design, urging design that meets actual human needs rather than the consumer market and cautioning against the social and ecological irresponsibility of modern industry. Rudofsky, Correa, and Papanek's theories gained particular significance during the 1973 energy crisis, which exposed the vulnerability of fossil fuel-based systems and sparked a renewed interest in sustainability, energy efficiency, and local resources.

Glenn Murcutt, active in the early 21st century, exemplified the effective implementation of these principles by creating climate-sensitive buildings that integrate traditional knowledge and environmental responsiveness. His architecture demonstrates that climate control is not merely a technical matter of shading or ventilation but an integral part of the building's form, section, and essence.

While Ioannou-Naoum does not directly cite these prior intellectuals, his research can be seen as belonging to the same continuum. His book bridges the theoretical and practical issues explored by Rudofsky, Correa, Papanek, and Murcutt, reaffirming the enduring principles of climate-responsive architecture and providing a methodological framework for future projects. The book examines traditional architecture across all climate zones, analysing key parameters that shape buildings in harmony with their environment. It demonstrates that attentiveness to materials, site conditions, and climatic factors – as emphasised by the earlier authors – remains essential for creating sustainable and comfortable spaces.

During periods of significant turmoil – regardless of whether climate change is the immediate concern – the book shows how traditional architecture has long adapted to local conditions, serving as a reminder that every site and location has its own rules to which architecture must respond. Materials, climate, and design solutions strongly influence planning, making this work not only a reference for a specialised study but also a universal guide for teaching traditional construction and sus-

tainable design principles. The author urges us to become *global architects*, capable of designing anywhere – in tropical, arid, temperate, polar, or continental zones – creating comfort for people rather than debating whether climate change is real.

Although the book offers concrete recommendations, it lacks an overall conclusion and a diagram summarising how similar or different techniques can be applied. Nevertheless, the primary strategy remains clear: observe traditional construction, be present, and experience the site firsthand.

Ioannou-Naoum's book has significant educational and pedagogical value. Offering traditional architectural building techniques as a framework for low-tech, climate-responsive planning, it provides students and practitioners with practical tools to design sustainably. The book covers all five climatic zones of the Earth, illustrating techniques from diverse, often non-European or historical societies. Its low-tech approaches are explained in clear texts and schematic drawings, offering inspiration for energy-autonomous and environmentally sensitive buildings. The comprehensive overview of centuries-tested passive techniques, combined with insights on building solutions, spatial concepts, materials, structural physics, design elements, and urban planning, makes the book a valuable resource for both teaching and practice – bridging historical knowledge with modern sustainable design principles.

As Vitruvius himself emphasised: “Just as the universe is organised by nature with regard to the Earth, in terms of the inclination of the zodiac as well as the orbit of the sun and its diversity, a building must be aligned with particular climatic conditions in different regions.”

In this way, Ioannou-Naoum's work connects centuries of traditional knowledge with modern design practice, completing the conceptual continuum initiated by Rudofsky, Correa, Papanek, and Murcutt. With the constant shifts and changes to which we are continuously exposed, the zones themselves might one day exchange places. However, with this handbook, we can design *from any point on the planet – for any point on the planet.*

TAMARA RELIĆ

ARCHITECTURAL CRITERIA FOR THE INTEGRATION OF HOME-BASED WORK IN RESIDENTIAL BUILDINGS

ARHITEKTONSKI KRITERIJI INTEGRACIJE PROSTORA ZA RAD OD KUĆE U VIŠESTAMBENIM ZGRADAMA



TAMARA RELIĆ (1991, Karlovac) She received her master's degree from the Faculty of Architecture University of Zagreb in 2017, where she started working as teaching assistant in 2018. Her scientific interest is focused on challenges and possibilities in housing.

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Dissertation data

245 pages, 9 chapters, 50 illustrations, 55 footnotes, 126 bibliographic units, and 36 catalogue units of selected examples

The phenomenon of working from home in multi-residential buildings is part of a broader research field examining the influence of digitalization and the development of communication technologies on everyday life. Two key developments have contributed to the growing number of people working from home and have made this topic particularly relevant within the current social, economic, and technological context: the digitalization and advancement of information and communication technologies (ICT) and the COVID-19 pandemic, which forced numerous companies and employees to work from home, at least temporarily.

An analysis of existing research shows that most studies focus primarily on the relationship between living and working within the live/work unit, without addressing the wider context of the multi-residential building or its immediate neighborhood. To address this gap, the present research examines historical precedents of home-based work and establishes a theoretical framework for studying its spatial dimension. Three fundamental relationships between living and working were identified, depending on the location of the workspace: integration within the dwelling, within the building, and within the neighborhood.

The research conducted for this thesis focuses on the architectural dimension of integrating home-based workspaces within multi-residential buildings, with an emphasis on the relationship between the work-from-home space and the shared building spaces. The building's ability to integrate home-based workspaces depends on various spatial, hygienic-technical, socioeconomic, and urban parameters analyzed through a Catalogue of Selected Examples. The aim is to establish a typological classification of both home-based workspaces and building types with home-based workspaces; and to define architectural criteria for integrating work-from-home spaces into multi-residential contexts.

The study identified four types of home-based workspaces, each characterized by a different degree of integration into the spatial structure of a multi-residential building: open workspace, transitional workspace, en-

closed workspace, and a grouped workspace. The intensity of integration varies across workspace types and corresponds to the level of spatial separation between the home-based workspace and the adjacent spaces.

The analysis of multi-residential building types revealed that buildings integrating home-based workspaces are characterized by complex spatial relationships among living areas, working areas, the building's shared spaces, and public spaces in the surrounding urban environment. Comparative analysis led to an expanded typology of six types of multi-residential buildings with integrated home-based workspaces:

1. buildings with home-based workspaces integrated within the dwelling;
2. buildings with home-based workspaces integrated between the dwelling and the building;
3. buildings with home-based workspaces integrated within the building;
4. buildings with home-based workspaces integrated between the building and the neighborhood;
5. buildings with home-based workspaces integrated into the neighborhood;
6. buildings with home-based workspaces integrated between the neighborhood and the dwelling.

This typology, together with the parameters shown to be relevant in defining building types and home-based workspace types – including the intensity of integration – served as a foundation for establishing architectural criteria for integrating home-based workspaces into multi-residential buildings. These criteria describe spatial relationships and patterns of building use rather than formal architectural expression, and they constitute the theoretical contribution of this research, forming a basis for future architectural practice. Four sets of architectural integration criteria were defined: (1) criteria for the home-based workspace, (2) the dwelling unit, (3) the building's shared spaces, and (4) the immediate neighborhood. Their goal is to support the positive interaction of two distinct

aspects of life – living and working – within residential environments.

Recognizing the importance of shared spaces in multi-residential buildings, a graphical spatial analysis was conducted on examples where home-based workspaces interact with communal areas. Two modes of integration were highlighted, depending on ownership status and usage model: home-based workspaces as privately-owned spaces and as shared communal facility. The analysis showed that, in both cases, additional shared spaces (such as expanded circulation areas or communal rooms) provide spatial and functional support for work-from-home, complementing rather than disrupting the dwelling's residential purpose.

The findings are discussed in the context of Croatia's Publicly Subsidized Housing Program (POS), the only regulated housing model in the country. The study identified limitations in existing regulations, particularly regarding the prescribed relationship between dwelling size and number of occupants, and the absence of positive standards for designing shared communal spaces for residents. While the POS program established valuable norms for regulating dwelling units and internal room layouts, earlier versions failed to set positive examples for the regulation of shared building spaces. No universal programmatic model of integration home-based workspaces can be applied to all contexts; instead, integration strategies must be adapted to the spatial, economic, and social conditions of each project.

The findings indicate the need to develop new socially subsidized housing programs that incorporate diverse spatial solutions and support alternative housing models capable of integrating home-based workspaces as part of the program. Within this context, the thesis proposes recommendations for improving the integration of home-based workspaces within multi-residential buildings. Such approaches can optimize the interaction between home-based workspaces and shared building areas, contribute to more adaptable and resilient housing typologies, and inform future socially oriented housing policies and architectural practice.

AZRA SULJIĆ



EMERGENCE OF A TYPOLOGY OF MONETARY INSTITUTION BUILDINGS IN CROATIA AT THE BEGINNING OF THE 20TH CENTURY

USPOSTAVA TIPOLOGIJE ZGRADA NOVČARSKIH INSTITUCIJA U HRVATSKOJ NA POČETKU 20. STOLJEĆA

AZRA SULJIĆ (1970, Zagreb), M.Arch., graduated from the Faculty of Architecture University of Zagreb, in 1995, CEO in ASK atelier d.o.o., licenced architect and urbanist.

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Dissertation data

386 pages (main text), 321 pages (research catalogue units), 348 bibl. units, 10 chapters, 778 illustrations, 32 tables, and 1040 footnotes

This Ph.D. thesis represents the first comprehensive examination of the monetary institution building type in Croatia during the late nineteenth and early twentieth centuries, within the disciplines of technical studies, architecture, and urbanism. Its aim is to define, analyse, and valorise a new typology of buildings designed for monetary institutions, i.e. structures intended to house banks, savings banks, insurance companies, and stock exchanges in the period between 1846 and 1929. The goal is to offer a new perspective on the significance of these buildings within the city's urban fabric, in the context of the development of European urban centres, particularly Vienna and Budapest.

The research establishes the emergence of this architectural typology in Croatia, delineating its principal formal and spatial components, along with its key characteristics and defining elements. It documents and systematises the most significant examples of such buildings from the Austro-Hungarian Empire's capitals, the larger centres of the Yugoslav region of the Empire and in Croatia. The basic architectural design principles behind the projects that were completed are also identified. Based on an analysis of a representative sample of monetary institution buildings constructed in Zagreb and designed by Croatian architects, their functional, constructive, and architectural design characteristics are established. The study identifies and assesses the distinctive design strategies employed in creating buildings characterized by heterogeneous functions. It also situates and analyses the contribution of Croatian architects to the development of this new building typology within the spatial and political context of the early twentieth century.

An analysis of the historical development of monetary institutions in Croatia has allowed for an emergence of four periods with relevance for this study. The first, 1846-1900, was the formative phase; the second, 1900-1914, was marked by the accumulation of capital in Croatia, and an increase in the number of buildings constructed; the third phase, 1914-1918, was characterised by stagnation as a result of the First World War and the fourth,

and most productive phase, 1918-1929, was marked by a powerful momentum in the construction of monetary institution buildings, and the culmination of the development of this building typology.

The thesis analyses the first examples of the buildings constructed in Vienna and Budapest for monetary institutions and synthesises their unique features, followed by a discussion of the criteria used to select fifteen representative examples of buildings constructed in Zagreb, and discussed in detail in a catalogue appended to the thesis. The criteria were: they are located in Zagreb; they were constructed within the established timeframe; they are the work of local architects; they were designed as entirely new buildings; and they were designed for heterogeneous purposes.

The results are presented in a comparative fashion, and the dominant characteristics of this building type are highlighted.

The contribution made by Croatian architects to the emergence of a new monetary institution building type in the early twentieth century is demonstrated through clearly defined parameters.

The architectural typology of monetary institution buildings in Croatia in the late nineteenth and early twentieth centuries is systematised through a precise definition of its formative elements and its relations with the urban context, within a clearly defined timeframe. It is valorised in a central European architectural context. The basic architectural principles and approaches that lead to high-quality spatial and functional solutions adapted to the specific needs of monetary institutions are defined, simultaneously activating the urban environment and constructing a powerful identity for the institutions themselves. The key elements include carefully selected sites, an authoritative urban position, a hierarchically elaborate spatial composition with an emphasis on the spaces for client-facing business (the vestibule and the cashier's hall), the selected style and the artistic and artisanal refinement of certain elements, a heterogony of function, and techni-

cal and constructional innovations. Through these elements, the functional and symbolic needs of the projects were successfully integrated. The thesis expands the knowledge about leading Croatian architects in the transitional period between the nineteenth and the twentieth centuries. Through this research, the clear interrelationships between the education of Croatian architects abroad, their professional relationships with the leading European architects of the period, and the influence that these relationships had on the design of monetary institution buildings in Croatia are recognised.

The central hypothesis of the thesis is that the establishment and development of monetary institutions led to the creation of a new type of building. This hypothesis is supposed by the analysis of examples from Zagreb. This building type developed under the influence of European architectural movements and socio-economic conditions. Vienna, the cultural and architectural centre of the Empire, had an overwhelming influence on the style and function of Zagreb's monetary institution architecture. The research also supports the second hypothesis, which is that the buildings of monetary institutions in Zagreb are characterised by good spatial organisation, constructional and design solutions, and an emphasis on representativity. The key characteristics of this building type can be recognised in design approaches such as maximal use of the building plot, drawing attention to the building with the addition of cupolas and monumental entrances, enhancement of the building's form with artistic works, and constructive innovations. The buildings become impressive city landmarks, and their architecture, which largely adopts the style of historicism, Art Nouveau, and the modern, communicate security, power, and the social standing of the institutions. The research also supports the third hypothesis, that at the beginning of the twentieth century, Croatian architects developed a new type of building for monetary institutions in Zagreb, relying on Viennese and central European models. Of the twenty-two projects constructed, nineteen buildings were the work of Croatian architects.

DASHNOR KADIRI

CRITERIA FOR CITY NEIGHBOURHOODS' PLANNING AND DESIGNING IN THE CONTEXT OF THE SMART CITY PLATFORM

KRITERIJI ZA PLANIRANJE I PROJEKTIRANJE GRADSKIH SUSJEDSTVA U KONTEKSTU SMART CITY PLATFORME



DASHNOR KADIRI (1987, Gjakova, Kosovo) is a graduate architect with a Ph.D. in Architecture and Urbanism from the University of Zagreb. He completed his Master of Technical Sciences in Architecture in 2014 and currently teaches at the University of Prishtina, Faculty of Civil Engineering and Architecture.

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Dissertation data

344 pages, 9 chapters, 6 illustr., 8 photos, 18 tables, 376 ref.,

Appendix (310 pages, 4 catalogues, 8 photos, 72 tables,

22 figures, 118 footnotes)

This research examines the smart city concept and explains how rapid advances in digital technology are reshaping urban planning worldwide. It recognises benefits such as better resource management, sustainability, greater energy efficiency, and reduced congestion, while noting unresolved risks to ecological viability, public inclusion, and personal privacy. The central claim is for human centred design that balances technology with resident wellbeing and place identity.

The research pursues four connected aims. First, it identifies gaps and biases in existing planning and design standards used in smart city contexts, many of which elevate technical metrics over social, psychological, and cultural needs. Second, it evaluates smart neighbourhood practice from inclusive and sustainable standpoints, documenting where privacy, accessibility, and cultural or psychological wellbeing are neglected. Third, it formulates revised criteria that reconcile innovation with human values, embedding mental health, community engagement, and equity into planning. Fourth, it insists on equitable access to municipal resources and services across income, age, ability, and location.

Methodologically, the research uses a purposive, multi stage case selection. From about two hundred European neighbourhoods, twenty were analysed in depth; five were then chosen through two step criteria and maximum variation sampling. Selection prioritised data sufficiency, maturity, scope, geographic spread, scale, governance models, and thematic focus. Cases with limited documentation or very narrow pilots were excluded, and close duplicates removed. Evaluation applies a six-domain smart city lens. Three primary dimensions frame the analysis: Smart Environment, Smart Living, and Smart People. Mobility, Governance, and Economy are treated as contextual facilitators. Objectives, interventions, outputs, outcomes, and evidence were coded to trace pathways from technology to lived effects. A critical review of global frameworks, including ISO 37122 and guidance from the European Union, the European Investment Bank, and the World Bank, finds strong attention to

governance, administrative efficiency, technical readiness, environmental indicators, productivity, and innovation, but weaker coverage of inclusion, equity, mental health, cultural continuity, and rights. Many schemes overprivilege instrumentation while underspecifying co-creation, stewardship, and long-term social resilience.

The research is organised in eight chapters. Chapter 1 situates the inquiry within debates on intelligent urbanism. Chapter 2 reviews trajectories, technologies, and challenges, using examples such as Barcelona, Singapore, and Copenhagen to show both promise and risk. Chapter 3 clarifies concepts, stakeholders, and models, noting concerns about surveillance and exclusion. Chapter 4 critiques top-down strategies and argues for hybrid, participatory planning. Chapter 5 assesses existing criteria and standards, highlighting blind spots around social experience and unequal access. Chapter 6 examines neighbourhood scale projects as laboratories that combine digital systems with green infrastructure and resident participation. Chapter 7 proposes revised planning and design criteria centred on inclusion, sustainability, governance, ethics, and privacy, with applications in Aspern, and Nordhavn. Chapter 8 sets out contributions and implementation pathways in scientific, professional, and educational domains, and redefines success in terms of people and environment.

Findings show recurring implementation gaps. Safeguards for privacy and data security are uneven; accessibility for underrepresented groups is inconsistent; and cultural or psychological wellbeing is rarely designed from the start. Where programmes succeed, they integrate green infrastructure, renewable energy, circular resource use, and inclusive mobility with local stewardship. Where they falter, technology advances faster than institutional capacity, and benefits skew toward advantaged districts. The research therefore proposes criteria that redefine what counts as smart: resident centred planning that pairs interoperable digital systems with place specific social programs; transparent data governance and clear opt-in consent;

metrics for equity, mental health, and cultural vitality; open standards and accountable procurement; robust participation and co-design; climate adaptation and nature-based solutions; and mobility and housing strategies that widen access without displacement. Mobility, governance, and economy are treated as cross cutting enablers rather than deterministic drivers. Policy and practice recommendations follow. Cities should establish participation baselines, require social impact and privacy assessments alongside technical business cases, and budget for ongoing stewardship rather than one-off deployment. Evaluation dashboards must include distributional indicators as well as averages. Procurement should reward modularity, re-use, and ethical data practices. Universities and professional bodies should integrate human centred smart urbanism into curricula so that planners, architects, and technologists can embed ethics and inclusion in projects.

The research contributes threefold. Theoretically, it reframes smart urbanism around human wellbeing and ecological integrity, clarifying trade-offs and offering shared language and structure for future studies. Methodologically, it demonstrates a comparative, mixed methods approach that links standards criticism with case outcomes through transparent selection and coding. Practically, it delivers criteria and guidance that city authorities, planners, and architects can use to design neighbourhoods that are technologically capable, socially inclusive, environmentally sustainable, and culturally responsive. Finally, the research argues for a shift from tech centric performance to people centred, equity aware, climate responsible urban intelligence. By aligning digital innovation with participation, ethics, and cultural context, smart neighbourhoods can move beyond pilots to durable value for residents, while universities help train the next generation to carry this approach into policy, practice, and education. The work also outlines a practical monitoring framework with clear indicators and responsibilities encouraging learning, transparent reporting and adaptive governance so that smart programmes stay accountable and resilient in time.

INES MRUVNAC SUŽNJEVIĆ



CRITERIA FOR PLANNING URBAN AND ARCHITECTURAL INTERVENTIONS WHICH IMPACT THE PANORAMIC IMAGE OF THE CITY

CASE STUDIES: EUROPEAN CITIES AS PART OF THE WORLD CULTURAL HERITAGE

KRITERIJI ZA PLANIRANJE URBANISTIČKO-ARHITEKTONSKIH ZAHVATA S UTJECajem NA PANORAMSKU SLIKU GRADA PRIMJERI EUROPSKIH GRADOVA SVJETSKJE KULTURNE BAŠTINE

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Dissertation data

528 pages, 9 chapters, 74 illustrations, 31 tables, 172 footnotes, and 143 bibliographic units

The dissertation examines the planning of urban and architectural interventions that impact the panoramic image of the city. The panoramic image, defined as an integrated visual construct comprising panoramas, silhouettes (skyline) and views, is understood as a multidimensional spatial expression of urban identity shaped by natural and anthropogenic features. The central thesis is that the panoramic image is not a passive outcome of urban processes but an identity framework that can be analysed, interpreted and applied in planning. The research therefore develops a system of criteria for assessing and planning interventions that influence the panoramic image of the city.

The definition of the panoramic image was developed through the synthesis of theoretical, historical and international heritage perspectives and the examination of its aesthetic, functional and symbolic dimensions. In this framework, the panoramic image integrates physical spatial characteristics, perceptual relations and the elements of panorama, silhouette and view into a single visual construct that reflects both the material structure of the city and its perception. Changes to the panoramic image influence the visual and cultural continuity of the urban landscape, as confirmed through the analyses of historical patterns in the formation of panoramic views and of the effects of contemporary interventions on their spatial and identity characteristics.

The methodological framework applies analytical, comparative and descriptive methods, typological classification, case study analysis and field observation within the approach of heritage urbanism. The research follows a multi-level analysis of European World Heritage cities. The initial sample comprised all 99 cities with formally protected historic urban areas, of which 56 explicitly recognise panoramas, views, silhouettes, the skyline, the image of the city or visual integrity in their Outstanding Universal Value statements. From this group, 21 typologically representative cities were selected, together with four detailed case studies – Rome, Vienna, Edinburgh and Dubrovnik.

The analysis examined the presence of panoramic attributes in heritage protection and confirmed that natural setting, morphological structure and the silhouette are commonly recognised as components of Outstanding Universal Value. It identified recurring spatial characteristics of panoramic images and their relationship to topography, settlement form and urban morphology, forming the basis for the development of planning criteria grounded in real urban contexts.

Across the studied European World Heritage cities, the panoramic image was found to be shaped by three groups of identity-forming characteristics: natural conditions that define geographical and topographic setting; anthropogenic characteristics such as urban scale, density and urban morphology; and the city silhouette formed in relation to the terrain. Together, these characteristics provide a stable analytical structure for comparative analysis. On this basis, a typology of panoramic images was developed, including types defined by spatial-topographic configurations, types related to perceptual complexity and types reflecting the relationship between natural and anthropogenic features, distinguishing static from dynamic panoramic images. The typology supports the interpretation of panoramic patterns in European historic cities and clarifies the spatial logic of their panoramic identity.

The four case studies further examined different planning systems addressing panoramic values in World Heritage cities. Despite differences in regulatory and analytical traditions, the cases reveal a continuum between restrictive conservation frameworks and adaptive models that integrate contemporary interventions into established identity contexts. Two planning approaches were identified: a conservation approach focused on preserving recognised visual spatial values and an adaptive approach aimed at ensuring coherent integration of new interventions. These recurring principles, confirmed in both the comparative sample and the case studies, form the conceptual basis for the criteria developed in the dissertation.

The synthesis of the theoretical, historical and comparative-analytical work, together with the identification of typologies, identity-forming spatial features and planning approaches, resulted in the development of a system of criteria for planning urban and architectural interventions that influence the panoramic image of the city.

The criteria were shaped by enduring principles identified in the comparative analysis, including the preservation of identity and visual recognisability, coherence with spatial context, the balance between conservation and transformation and systematic impact assessment.

The criteria are organised into four groups: (1) contextual and identity criteria, including cultural-historical consistency and continuity, preservation of Outstanding Universal Value and alignment with local spatial characteristics; (2) morphological criteria, including proportionality and alignment with the urban scale, preservation of the skyline, protection of views and the spatial form of buildings; (3) functional criteria, relating to land use, public open spaces and the integration of transport, utility and green infrastructure; and (4) criteria of sustainable management, including sustainability and climate resilience, management of tourism pressures and the participation of users and the professional community. Each criterion is defined through a clear rationale, purpose and qualitative or quantitative indicators to support its application during the planning process.

The scientific contribution of the dissertation lies in the analysis of urban spatial identity in European World Heritage cities and in the development of a theoretical and methodological framework for planning interventions that affect the panoramic image of the city. The professional contribution is reflected in the formulation of criteria and assessment indicators applicable in urban and architectural practice, while the educational contribution arises from the possibility of integrating the results into teaching in urban planning, architecture and heritage protection.

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