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The Vernacular Courtyard Architecture: A Reference for Contemporary Housing Models — The Case Study of Hanoi

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Abstract: This study explores the potential of vernacular courtyard architecture as solution to contemporary urban housing challenges, which include social disconnection, environmental degradation, and rapid urbanization. Modern housing models often emphasize density and economic efficiency, overlooking essential aspects of social interaction and environmental sustainability. Vernacular courtyard houses, however, have historically fostered social cohesion and environmental responsiveness through shared, shaded communal spaces, natural ventilation and privacy. By examining these traditional forms across diverse cultural contexts, our research aims to identify design principles that can inform contemporary housing. Using a mixed-methods approach, this study combines qualitative and morpho-typological analyses of historical examples with a literature review and examines modern adaptations inspired by courtyard designs. The Italian Tendenza school's insights help frame the typological and morphological analysis, emphasizing how courtyard housing shapes and interacts with urban form. Additionally, the focus on "void" spaces in courtyard houses reveals their role as social and environmental moderators. To illustrate these principles, we present one of the chosen case studies, that of Hanoi, where traditional courtyard houses remain integral to the urban landscape. Our findings advocate for adapting vernacular courtyard housing principles to contemporary housing, bridging past architectural practices and future design needs, and promoting resilient, socially inclusive, and sustainable urban living.

Key words: vernacular architecture, courtyard house, social interactions, housing quality

1. Introduction

As societies grapple with issues of social disconnection, environmental degradation and rapid urbanization, there is an increasing recognition of the limitations inherent in many modern housing buildings. These buildings often fail to meet the real needs of residents, prioritizing density and economic efficiency at the expense of social interaction and environmental sustainability. Despite a renewed interest in shared and communal spaces within urban design, few contemporary housing projects effectively incorporate these elements into their layouts, leaving a gap between conceptual interest and practical application.

Whit this in mind, the vernacular courtyard house, an enduring architectural type, presents invaluable insights for addressing the housing challenges of contemporary urban environments. Courtyard houses, found across diverse cultural and geographical contexts, embody principles that foster social cohesion and environmental responsiveness. From European to Asian, from African to American architectural traditions, courtyard housing has historically provided residents with shaded communal spaces, natural ventilation and privacy — qualities that support both social interaction and sustainable living. Hence, our study seeks to examine vernacular courtyard housing as a potential solution to the challenges of the contemporary metropolis. By analysing traditional courtyard houses, our research aims to uncover design

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principles that can inform contemporary housing models, enhancing their capacity to address the complex demands of contemporary urban life. By exploring the potential of the court, this study seeks to demonstrate how vernacular models can serve as a model for more sustainable and socially integrated housing in contemporary living.

By examining both historical and contemporary examples, we aim to demonstrate how the architectural and construction principles underlying vernacular courtyard housing can be adapted to modern needs, bridging the gap between past architectural practices and future design challenges.

To illustrate the application of these principles, the paper delves into the case study of Hanoi, a city where traditional courtyard houses remain integral to the urban fabric. Through this analysis, the study advocates for a renewed appreciation of vernacular courtyard housing, proposing it as a valuable reference point for developing resilient, socially inclusive, and environmentally sustainable housing models.

2. Objectives and Significance

This research holds significant potential for contributing to sustainable and socially inclusive housing solutions.

By uncovering design principles from vernacular courtyard housing that promote natural ventilation and lighting, shaded communal spaces and climate-responsive features, the study aims to support the development of housing models that address environmental sustainability in densely populated cities.

The study also emphasizes the importance of promoting socially inclusive housing models in contemporary urban contexts. Courtyard houses, characterized by a strong focus on shared spaces, promote social interaction and community cohesion — qualities that are increasingly valuable in urban settings where social isolation is likely to be prevalent. By advocating for housing designs that prioritize community, this research proposes a framework for creating more socially supportive residential environments.

Furthermore, this study bridges historical and contemporary architectural practices by connecting traditional design principles with current urban challenges. Indeed, through a detailed analysis of vernacular courtyard houses and their potential applications in today's urban landscapes, this research proposes a renewed appreciation of traditional architectural models. By demonstrating how these principles can inform future housing models, it offers a pathway for architects, urban planners and policymakers to incorporate the strengths of vernacular architecture into sustainable, resilient, and inclusive housing for the future. Preservation and adaptation of vernacular architectural practices is another key topic. By showing the enduring value of traditional courtyard designs in the face of modern requirements, the study showcases the potential for incorporating time-tested architectural principles into contemporary settings. This approach not only demonstrates the enduring relevance of traditional designs in modern architecture but also preserves cultural heritage.

Additionally, the research findings could provide valuable insights for policy and urban planning, supporting initiatives that prioritize sustainable and socially inclusive housing. These insights could influence how urban spaces are developed, guiding planners and policymakers in creating residential areas that balance economic, environmental, and social considerations.

In sum, by bridging past and present, this research highlights the potential for vernacular models as resilient frameworks suited to address the complexities of modern urban living. It promotes a renewed understanding of how vernacular architectural principles can be adapted to the evolving needs of cities and communities, providing a useful basis for more sustainable and inclusive housing in the 21st century.

3. Literature Review

The study is based on a literature review that explores historical, architectural, sociocultural, and environmental perspectives on courtyard housing are explored, with a focus on how Hanoi's historical housing models serve as a reference for contemporary housing design.

Concerning the historical background of courtyard housing, the literature underlines that courtyard houses are one of the oldest types of residential architecture, found in various parts of the world, from the Mediterranean to Asia, from Africa to South America. *Courtyard Housing and Cultural Sustainability: Theory, Practice, and Product* by Brian Edwards [1] offers an in-depth study of courtyard houses discussing their historical significance and cultural adaptations across regions. The work of Brian Ford, Philip Steadman and Mary Crowther, *The Courtyard House: A House for All Climates* [2], traces the architectural and environmental principles of courtyard houses globally, from Mediterranean to Asian designs. Focusing on the Italian context, *L'architettura domestica: Il modello della casa a corte* by Sergio Bettini [3] instead analyses the courtyard house model within Italian and Mediterranean contexts and provides insight into its origins and historical evolution.

Several researches on vernacular courtyard houses in southeast Asia, like *Vernacular Architecture in the 21st Century: Theory, Education, and Practice* edited by Lindsay Asquith and Marcel Vellinga [4], focus on courtyard designs adapted to tropical climates. The work of Lawrence D. Bess, *Traditional Vietnamese Architecture: Ancient, Vernacular, and Colonial Styles* [5], is essential for understanding traditional Vietnamese architectural forms, including courtyard houses, especially within the broader Southeast Asian vernacular tradition. The Italian *Architettura vernacolare in Asia: Tradizioni costruttive e pratiche locali* by Marco Dallari [6] also focuses on the cultural and climatic adaptations in courtyard housing across Southeast Asia, including an in-depth look at courtyard houses and their socio-cultural role.

These sources provide a multidisciplinary perspective on courtyard houses' origins, cultural adaptations, and specific case studies such as Hanoi and Southeast Asia.

4. Methodology

1) Utilizing a typological and morphological analytical framework, the study integrates a multi-scalar examination of urban forms and architectural types through the systematic investigation of historical and contemporary case studies. This methodological approach is reinforced by an extensive and critical literature review, enabling a diachronic and synchronic assessment of spatial configurations, evolutionary patterns, and socio-cultural determinants. By correlating morphological transformations with typological changes, the research aims to elucidate the structural logics underlying this shift, the adaptive processes and the interactions between built form and urban dynamics.

Drawing on the theoretical contributions of the Italian Tendenza school [7], our study investigates the typological and morphological attributes of courtyard housing by examining its spatial organization, formal variations, and structural principles within different urban contexts. The typological analysis focuses on the evolution of the courtyard house as a recurrent architectural archetype, assessing its configurational logic, functional adaptability and socio-cultural significance across historical and contemporary settings. Meanwhile, the morphological approach interrogates the spatial syntax and geometric properties of courtyard layouts, emphasizing their articulation with urban fabric, plot structures, and regulatory constraints. By analysing these aspects, the study elucidates the enduring relevance of courtyard housing in responding to climatic, social, and spatial imperatives.

2) The comparative analysis of courtyard housing along the ancient Silk Roads adopts a diachronic perspective, examining historical prototypes alongside contemporary reinterpretations to assess the typological continuity and adaptive transformations of this architectural form. Historical case studies are selected based on their architectural significance, spatial configuration, and cultural embeddedness, allowing for an in-depth examination of their formal principles and socio-environmental functions. In parallel, modern adaptations inspired by vernacular courtyard typologies are analysed to evaluate their capacity to respond to contemporary urban, climatic, and social challenges. By systematically comparing spatial forms, morphological patterns and functional adaptability across different temporal and geographical contexts, the study elucidates the resilience of the courtyard house as a spatial model, demonstrating its capacity to mediate between tradition and innovation in the evolution of urban housing typologies.

3) The fieldwork conducted in Hanoi integrates a holistic and qualitative approach to spatial analysis, emphasizing direct observation, spatial perception, and interpretative inquiry. Through sketching, architectural mapping, and an immersive study of residents' spatial practices, this research seeks to develop a multifaceted understanding of Hanoi's courtyard houses from the following perspectives:

a) Architectural analysis: a comprehensive examination of the architectural characteristics of Hanoi's courtyard houses, focusing on materiality, spatial configuration, and environmental adaptability. Particular attention is given to the role of design and orientation in regulating airflow, controlling solar exposure and enhancing thermal comfort, thereby elucidating the intrinsic relationship between built form and climatic responsiveness.

b) Socio-spatial dynamics: analysing the ways in which courtyard houses foster social interactions, community cohesion, and intergenerational cohabitation. This includes an exploration of spatial appropriation practices, the flexibility of domestic functions and the reciprocal relationship between built environment and social structure.

c) Environmental sustainability: investigating the integration of passive climate control strategies, such as natural ventilation, daylight optimization, and thermal mass regulation, alongside the use of low-impact and locally sourced materials like bamboo, wood, and stone. The study positions these vernacular principles within contemporary discussions on sustainable urban living and ecological resilience.

d) Comparative typological analysis: conducting a cross-cultural examination of Hanoi's courtyard houses in relation to other courtyard typologies, such as the Chinese *siheyuan*, to identify common morphological and functional attributes. This comparative perspective seeks to uncover transferable design principles that could inform contemporary approaches to sustainable and socially inclusive housing.

e) Contemporary adaptations: exploring how vernacular courtyard housing principles are reinterpreted within the context of ongoing urbanization, with a focus on contemporary architectural interventions in Hanoi. This analysis investigates the ways in which traditional spatial logics are adapted to new socio-economic and environmental constraints, offering insights into the evolving relevance of courtyard-based urban dwelling models.

By integrating these analytical dimensions, the study advances a holistic understanding of courtyard housing as both a historically embedded and dynamically evolving architectural paradigm, linking spatial morphology, environmental performance and socio-cultural significance.

5. Findings

5.1 Oriental and Occidental Courtyard Vernacular Architecture

The history of the ancient Silk Roads remains shrouded in uncertainty [8, 9], yet over centuries these

routes facilitated the exchange of people, goods, and knowledge between East and West. Asia, renowned for its vast empires and civilizations rooted in rich cultural and philosophical traditions, captivated the imagination of many Europeans. Alongside the exchange of exotic objects and materials like glass and spices, knowledge in agriculture, metallurgy, and animal husbandry flowed across continents, weaving a tapestry of cultural interconnection that reaches back to prehistoric times.

Within this vast interconnected territory of villages and towns, distinct architectural typologies emerged, shaped by both local environments and intercultural exchanges. Courtyard houses, in particular, manifest deep-rooted similarities across regions, exemplifying a harmonious interplay with the environment and social structures. When we examine the domestic architecture of the two monumental empires at the termini of the Silk Roads — the Roman and Chinese empires — the central role of courtyard spaces becomes evident, with the courtyard serving as a fundamental architectural element.

In ancient Rome, written sources from the imperial era describe open-air spaces known as *cohors* that evolved into central courtyards, pivotal to domestic life. In *De Architectura* [10] — the sole surviving architectural treatise from ancient Rome — Vitruvius mentions the *cohors* in his description of rural houses, where it functioned as a farmyard, accommodating both work and social interaction. The design and dimensions of these spaces were dictated by functional needs, such as the number of animals and tools required for agricultural work. The surrounding structures included kitchens, cellars, baths, and storage rooms on one side, with stables and animal enclosures on the other, forming a volumetric composition around this central open space. In these rural houses the courtyard was an open, fluid area, shaped by the layout of the buildings surrounding it, and not defined by precise architectural rules. It was a space where daily activities unfolded under natural light, while shaded porches provided comfort during the summer. Here, humans and animals coexisted in a cohesive domestic environment, with the dog acting as a guardian of both household and courtyard.

Vitruvius also references urban houses of aristocratic families, which were distinguished by more structured open-air or semi-covered spaces, indicative of social status and wealth. In these houses spatial hierarchy is expressed through distinct courtyard types, each with a unique name, form, and function. The *atrium*, located at the entrance, served as a reception area, its design varying according to the proportions of the overall plan. Adjacent to this was the *cavaedium*, an elaborated variant of the *atrium*, covered with canopies or vaulted ceilings, enhancing its grandeur. The *peristylium*, a larger courtyard surrounded by porticoes, served as the main open-air space, allowing light to penetrate surrounding rooms and providing an ordered, unifying focal point within the house. These distinct courtyard spaces — *atrium, cavaedium,* and *peristylium* — not only provided structural and aesthetic order but also embodied the Roman ideals of social distinction and spatial hierarchy. Through this typological framework, the courtyard became more than a functional element; it was a locus of social identity, environmental adaptability, and architectural sophistication, offering insights into the complex relationship between architectural form and the cultural contexts that shape it [11].

As demonstrated in previous research on courtyard housing [12, 13], the organization of these historical residential structures around a central courtyard has profoundly influenced the architectural form of Italian Renaissance *palazzi* and French *hôtels particuliers*. This spatial arrangement, which integrates private and semi-public realms around a significant void, began to wane with the advent of the industrial revolution in the 19th century. The densification of urban areas and the emergence of new housing types led to a gradual disappearance of the courtyard typology, though contemporary architectural practice has revisited this

form, exploring its ecological and social potential in urban settings.

In parallel, the *siheyuan* of China (Fig. 1) illustrates how traditional architectural structures can foster community cohesion and a close relationship with nature. In historic Chinese cities, like Beijing and Suzhou, courtyard housing exemplifies architectural principles deeply rooted in Confucian philosophy, particularly the pursuit of harmony in human relationships and the integration with the natural environment. With a heritage stretching back 3.000 years, these structures reflect ancient land tenure systems and enduring urban practices. Originating in the Shang period (circa 1600-1046 BC), these systems organized land into sections with a communal field at the centre and private plots for surrounding families [14]. This spatial arrangement underpinned social order, creating a harmonious balance between individual and collective spaces. The Beijing *siheyuan,* characterized by a square layout centred on an open-air courtyard, serves both functional and symbolic roles. Surrounded by rooms that open inward, these courtyards provide light, ventilation, and views while ensuring privacy and security. The modularity of the *siheyuan* allows for adaptive extensions based on familial needs, embodying flexibility within a stable architectural framework [15-17]. Additionally, this arrangement mitigates environmental factors, controlling noise and pollution and creating a sheltered space for cultural activities and communal gatherings. In addition, the interstitial spaces between buildings, known as *hutongs*, facilitate ventilation, light, and social interaction among neighbours, reinforcing community ties.

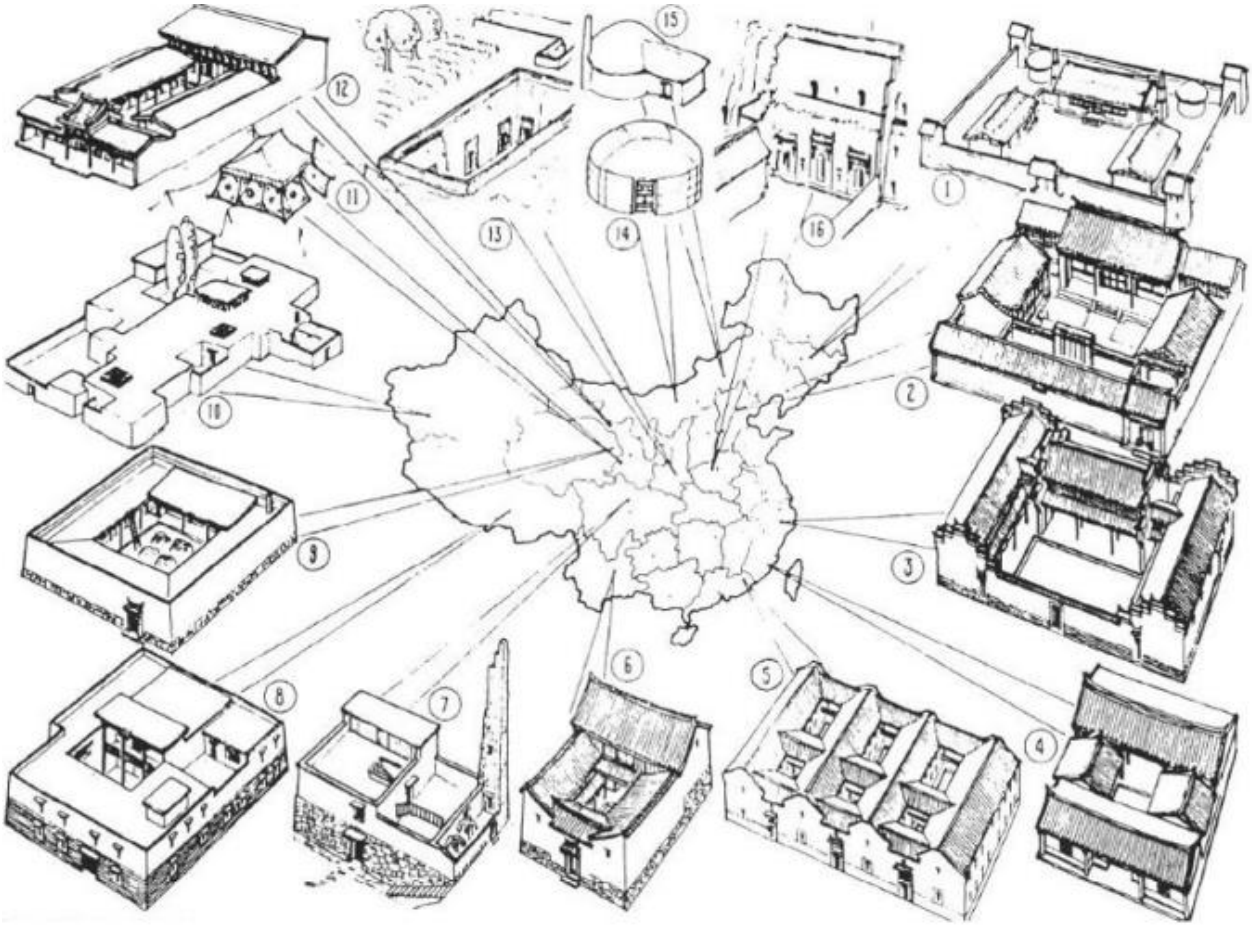

Fig. 1 Variation of courtyard houses in different Chinese countries (Source: © ZHU and FU, 1988).

The design of *siheyuan* adheres to principles encapsulated in the term itself: "*si*" refers to the four sides — east, west, north, and south — that enclose the courtyard, while "*he*" signifies enclosure, implying a cohesive, inward-facing organization with a central garden. This form, which isolates the courtyard from the outside world when its single entrance is closed, represents a deeply ingrained cultural value of privacy and familial unity. The remaining *siheyuan* structures, primarily dating from the Ming (1368-1644) and Qing (1644-1911) dynasties, exhibit features such as carefully placed furniture, intricately designed wooden doors and windows, and distinctive brickwork and eaves, each element echoing the pursuit of harmony. This spatial and aesthetic harmony parallels Aldo Rossi's concept of genius loci [18], akin to the Confucian ideals and feng shui principles that guided these structures' design. These principles sought to align the built environment with cosmic and natural order, thereby enhancing comfort and quality of life.

However, the structural integrity and cultural resonance of these traditional houses have been eroded by shifts in social organization and urban policy. With the establishment of the People's Republic of China in 1949, the transition from private to state or collective ownership altered the function and use of *siheyuan.* Many were subdivided among multiple families, transforming private family spaces into shared accommodations. The subsequent wave of modernization, marked by developments such as the construction of the metro in the 1960s, further disrupted these traditional urban fabrics. These transformations reflect broader tensions between preservation of cultural heritage and the pressures of urban growth and modernization, underscoring the challenge of maintaining the cultural and spatial integrity of courtyard housing in contemporary urban contexts.

These two traditions of courtyard houses can be compared with other examples along the ancient silk roads, which show significant variations in the size and structure of the open or semi-covered spaces, due to climatic differences or the specific use of the buildings.

In Venice and in the Balkans, for instance, the shape of the palace presents a large central living room, a sort of covered patio, which distributes the side rooms. Called *salone* in Italy and sofa in Turkey (Fig. 2) and the East Mediterranean, this space has the same function as the covered atrium in the villas of the ancient Romans. The Ottoman house is for this also called sofa house: it is characterized by the presence of this common space on the floor plan that gives access to all the other rooms and forms a connection between the inside and outside, like a square or a street within the house [19].

Whether built in villages or towns, for peasant families, merchants or aristocrats, over the centuries the vernacular house has reserved a special role to courtyards and open spaces around which the buildings are organised. All of these traditional spaces at the heart of the home determine rhythms and uses of daily life. Mainly dedicated to sharing, these intermediate spaces allow citizens to strengthen and modulate the intensity of social relationships, articulating private and community spheres and promoting social intensity within a balanced urban density. At the same time, they generate a high-quality urban living thanks to the opening towards the external space which offer natural light and ventilation. In fact, in most cases these models derive from a virtuous design process which seeks the integration and wise use of natural elements.

Fig. 2 An example of the Turkish Sofa House (Ph.: © Acciai Serena).

On those grounds, they represent a powerful driving force in the development of better-quality housing models in 21st century society, oriented at rebalancing the careless use of natural resources and recovering the authenticity of human relationships. Hence, as we transition to modern contexts, the principles derived from these historical models can inform housing designs that prioritize community, sustainability, and resilience against contemporary challenges such as pandemics, climate change and urban density.

5.2 The Hanoi Case Study

Hanoi, the city "between the waterways" [20] and the capital of Vietnam, lies on the right bank of the Red River. The city experienced a strong growth during the 20th century, during which modernity and local culture merged abruptly. Nowadays, it is the second most populous city in Vietnam (approximately 8.3 million of inhabitants in 2023) and it is continuously demographically and economically developing.

Bordered to the north and south by two lakes — Ho Tay Lake and Hoan Kiem Lake, to the west by the Song Hong (the Red River) and to the east by the imperial citadel of Thang Long, the core of the city is the ancient "36-street district", a reference point for Vietnamese urban identity. The ancient district came into being at the beginning of the year 1000, together with the imperial citadel. Originally, it was no more than a collection of market stalls located east of the imperial walls, serving as a marketplace for the region's trade and the main supply centre for the Citadel.

The articulation of the newly formed neighbourhood echoes the organisational structure of the villages, each of which was traditionally based on a specific craft or agricultural activity (rice village, silk village, etc.). In fact, the same separation by profession is present in the urban organisation model, in which each street specialises in the same trades or type of products, as shown by the name of the streets. Therefore, inhabitants of the same street generally came from the same village, transposing an extension of the social and family life from the village into the city. Like a small "city within a city", each street is an autonomous urban microcosm [21]. Likewise, the Hanoi's urban house was originally derived from the typical rural house.

Generally square in shape and surrounded by a fence, the rural typology was organized around an internal courtyard. The plan of the main volume, flanked by smaller annexed volumes intended for specific activities, was made up of the alternation of regular spans. The main rooms included, in sequence, the ancestral altar, the living room and the dining room, where guests were received. This part of the house opened onto the courtyard, which is where most of the family and social life activities took place [22].

Originally, the villagers also owned small temporary premises near the Citadel to trade periodically, thus maintaining a shop in town and a village house at the same time. As trade activities increased and because of the distance from the villages, the original shops expanded to allow longer stays in the town. The original small volume, used for production, sales and storage, therefore constitutes the first nucleus of the new urban house, which takes up and reinterprets the traditional village house maintaining some of the main spatial principles: the organisation of the living spaces around an internal courtyard hosting most of the activities, the decomposition of the house into volumetric cells hierarchically organised, the maintenance of reduced heights. The materials are also similar, involving mostly natural and local supplies (wood or bamboo, cob, straw). Traditional Vietnamese architecture, in fact, testifies to a strong relationship between man and nature, deeply rooted in the design of buildings. The materials used in traditional architecture were carefully chosen to suit the tropical climate and local resources, allowing for great architectural flexibility and adaptation to changing climatic conditions. At the same time, the lifespan of buildings is limited to that of the materials: houses are cyclically rebuilt or partially replaced.

However, the planimetric form and the volumetric development of the urban typology undergoes significant changes compared to the original prototype, depending on the more stringent constraints imposed by the city context. The fiscal policies introduced by the government feudal system taxed the façade width of the shop, which therefore tended to develop in depth. At the same time, given the growing urbanization and rapid commercial growth, authorities had to guarantee as many people as possible to exhibit their products [22]. The land, now organized by a network of streets, was thus divided into elongated lots about four meters wide, just enough for a shop. Subsequently, the houses grafted onto the commercial cell followed the narrow path, giving rise to the so-called "tube house". The overall volumetric development occurred along the depth of the lot, generating the characteristic front on the street made up of very tight facades. Furthermore, the need to ensure the lighting of the living spaces and the evacuation of rainwater from the roofs imposed a particular spatial organisation: based on the alternation between closed rooms and an open-air courtyard, the new housing typology recall the layout of the artisans' shop houses in the ancient cities, such as Pompeii and many evocative examples of Roman houses. In fact, since the merchants definitely moved into the city, other living cells were added to the original commercial one, interspersed with open spaces that take up the role played by the original large courtyards. A secondary factor which probably influenced the development of this typology over time can be attributed to the custom of adding a portion of the house for each member of the family who married, providing the interposition, between the segments, of a crossable courtyard.

The arrival of Chinese merchants further influences the new urban landscape and the domestic habitat, which is affected by the "shop house" Chinese model. Similar to the Vietnamese model due to the alternation of functional cells and courtyard, the Chinese house is characterized by a more accentuated commercial relationship with the street; all commercial functions are carried out on the ground floor, while the accommodation with residential functions is located on the upper floor. Furthermore, since the merchants possessed a major wealth, the buildings were made with more durable materials such as bricks, wood and handmade tiles. The traditional urban house therefore derives from the fusion of the rural model and the Chinese commercial house, but the main characteristic remains the alternating organization of courtyard and closed portions according to a precise spatial hierarchy (Fig. 3). From the street front towards the back of the lot, the rooms gradually pass from public to more private functions, allowing an orderly and hierarchical management of components, uses and privacy.

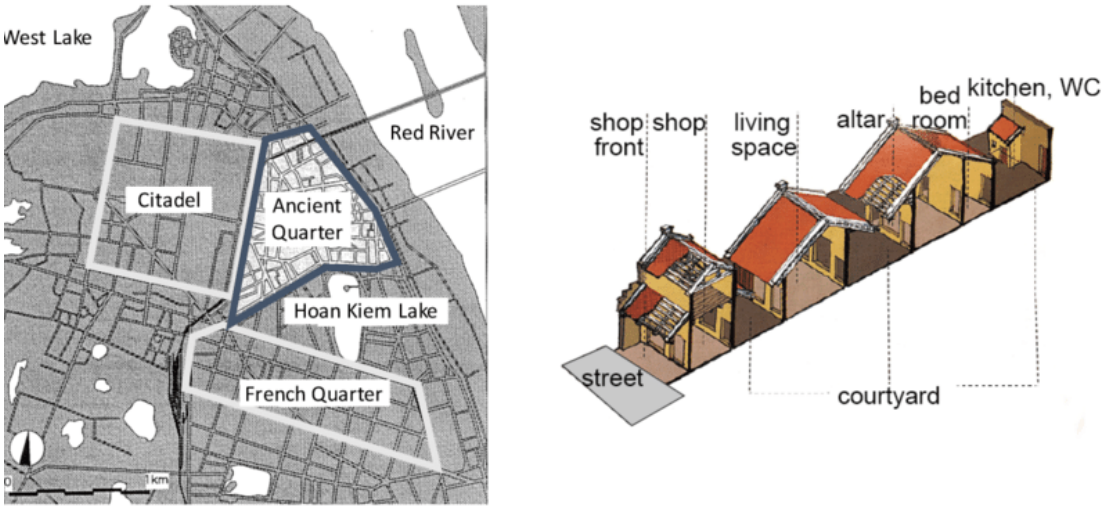

Fig. 3 The spatial configuration of traditional tube house in Hanoi's Ancient Quarter (Source: © Ban quản lý phố cổ).

The entrance to the house from the street is covered and constitutes a filter zone between the public space and the private home. In this area, during the day, the shop temporarily extends onto the street and the merchant owner sets up his exposition. Hence, the first part of the house is mostly intended for trade and generously open to the street. Non-traders privates modify the openings on the facade, although the internal division remains the same. The first room is therefore used as a shop or to welcome guests. Then placed in sequence, the first courtyard contains the *impluvium,* of which the cistern can be placed in the centre or laterally. To the side of the courtyard, a covered passage leads to the second part of the building, the proper domestic space. As with the three central bays of the rural house, the domestic altar and the dining room are present in sequence. There are also men's and women's bedrooms, storages and service rooms such as the kitchen and the toilet. The buildings sometimes have a small mezzanine, reachable via an internal staircase, in which the most private rooms are located. However, until the French occupation, the height of houses remained severely constrained by imperial regulations which, for safety reasons, prohibited private individuals from raising their single-story homes and opening windows to the street on the upper floors: in fact, it was forbidden to build a house that exceeds the height of the imperial palanquin when carried by porters. So, until the mid-nineteenth century the facades remained one story or one and a half stories high, all the raised rooms only overlooking the internal courtyards (Fig. 4).

The access to the house is mostly central and staggered from the rest of the route, while pedestrian paths mainly take place laterally along the length of the lot. Thus, the access to the private spaces is more protected from the main entrance, also intended for public use. However, there are no physical separations between the circulation areas and the private rooms, which remain poorly bounded: in the typical

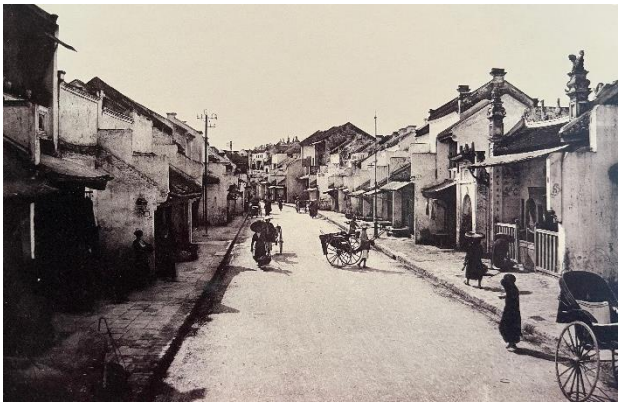

Fig. 4 Historical photos of the 36 streets old quarter of Hanoi (© Hanoi city archives).

single-family house, intimacy and spaces are almost always shared. The openings on the courtyards are aligned, thanks to which it is possible to create deep views that permeate the entire length of the lot. Separations between indoor and outdoor spaces, such as between living rooms and courtyards, are made by means of slight drops, filled by one a few steps. Boundaries are not physical barriers but are suggested through dematerialised signs of separation. Likewise, the distinction between work and family rooms is labile and permeable, occurring through tilting panels. In fact, the rooms are divided by movable and folding wooden panels. These elements play a very important role in the versatility of the spaces and the flexibility of uses, as they allow to modify the privacy and the uses depending on the needs or the time of the day. These panels also contribute to the management and modulation of natural light and ventilation, still ensuring adequate circulation even when they are closed thanks to the permeable upper part.

All the internal rooms project towards the courtyards, the centre of views and daily uses, reinforcing their key role in domestic life (Fig. 5). As well as the courtyards of the village houses, these internal patios host different uses and serve as places to spend common free time or carry out different housework, such as cooking or hanging laundry.

The presence of these empty spaces represents, besides, an efficient expedient to manage the local

climate with a strong impact on internal thermo-hygrometric comfort (Fig. 6).

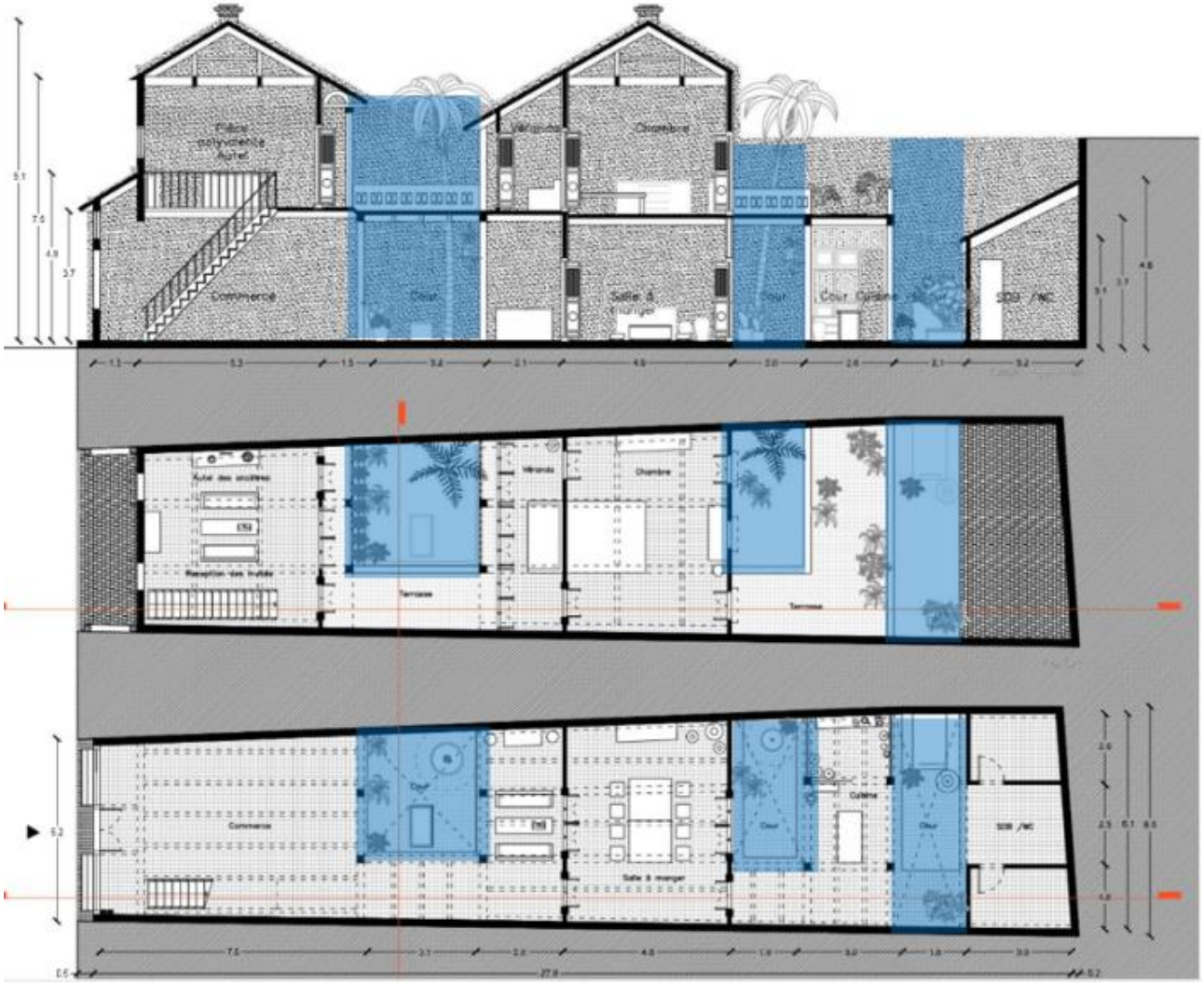

Fig. 5 Plans and section of the 87 Ma May house, a historical dwelling preserved to this day (Source: © Folio G, 2020)

Fig. 6 Photos of the 87 Ma May house, a historical dwelling preserved to this day (© Cristiana Mazzoni, 2023).

The climate has indeed strongly influenced the construction of this architectural typology. The shape and the slope of the roof are designed to channel rainwater towards the centre, into the inner courtyards with permeable ground, where there is a collection point allowing rainwater to be reused. At the same time, this solution allows the façades to be protected. In addition, ventilation permeates into the depth of the plot thanks to the inner voids, filtering into the enclosed spaces through the permeability of the façades and panels. At night the interior panels can be opened to let in the fresh air, while during the day the air circulates along the plot passing through vegetation and water in the courtyards, through which it is cooled along the way. At the same time, roof overhangs protect against solar radiation as do wooden panels that act as sunbreaks, while the presence of verandas interposed between rooms and courtyards generates "buffer zones" to control indoor temperature. The volumetric form and architectural components are also designed to adapt to the climatic context: the size of the courtyards and the depth of the overhangs are perfectly adapted to the local solar incidence, allowing the winter sun to penetrate all rooms while attenuating the summer sun.

Moreover, the courtyards represent important light sources that convey the entry of natural light into all built parts, despite the depth of the lot. The overhangs, which contribute to provide protection from sunlight, are never too protruding, thus allowing for good light entry in uniform amounts, also thanks to not too deep interior rooms.

Hence, this organic spatial and architectural system, inherited from rural vernacular houses, overall allows for a comfortable and healthy environment. Even under the French occupation, which significantly changed the overall urban form and the vocabulary of the facades [23], the internal organization of domestic spaces remained under the control of the inhabitants so that the traces of this identitarian housing typology have never been deleted. Even if it undergoes substantial modifications over time, the "*compartment*" remains as organizing model both of Vietnamese urbanity and domestic life, as a mirror of a family and social organization and a way of living [24].

However, over time and especially from the 20th century, the neighbourhood has undergone a radical and unplanned transformation. Housing density has increased dramatically, changing the original urban structure and, most of all, the original conformation of the "tube houses", virtually intact until the 19th century. The insertion of accretions to maximize built space resulted in the closure of open surfaces and the elevation of the entire structure, preventing adequate ventilation and lighting of the inner living spaces. Today, the tube houses go up to five or six stories, the lots of the 36-street neighbourhood are on average 80% occupied [25]. In the long term this uncontrolled and aggressive building policy risks causing disruption to this part of the city, wiping out the lifestyles, customs, activities and traditions that form the basis of the local urban identity.

Nevertheless, it is possible to find some original characteristics of the vernacular typology in few contemporary interventions scattered throughout the city, which have been able to reinterpret the central role of the courtyard. An example of this is the house located in the Pham Dinh Ho district of Hanoi (Fig. 7).

This three-level home is built around an open central patio. It was designed by a young Vietnamese architect who wanted to reinterpret the essence of the Hanoi vernacular house. The entire life of the house revolves around this space, which serves as the central gathering spot for family members and provides direct access to the kitchen.

The inhabitants experience it as an intermediate, semi-private space where they can invite neighbours or friends to chat and sip a good tea away from the noise of the street. Although the house is located at the depth of a long lot, the presence of the patio allows for a good supply of natural light and promotes natural ventilation in the rooms. At the same time, the presence of a large

tree in the centre of the house allows for good shading in the hottest periods. For this reason, the inhabitants live in a pleasant climate throughout the year without the need to resort to energy-intensive air conditioning or heating.

Fig. 7 Contemporary home around an open central patio. Pham Dinh Ho district, Hanoï (© Cristiana Mazzoni, 2023).

Another significant example is represented by the CH House, designed by ODDO Architects. In an effort to introduce natural light, ventilation and greenery to a long, narrow lot (4.2 m wide and 35 m long), the architects proposed a contemporary take on Vietnam's traditional tube house with the aim of adapting it to meet modern needs and concerns (Fig. 8).

Consistent with the tradition that informs the traditional house, the designed building is mixed-use: it houses a commercial space and a residence for a family of six members.

Thus, the linear structure with five floors meets the different needs of three generations under one roof. Imitating the typological distribution of a tube house, the CH House hosts commercial spaces on the ground and first floors, while residential spaces are on the top three floors.

The residential areas are divided into staggered levels, connected by multiple staircases located in double and triple height spaces. With the aim of providing natural light and ventilation, the project involves several emptying in the section of the building, allowing zenithally light to enter from the roof through internal voids that cross two or three floors.

These voids, as well as the small patios that cross and connect different levels, constitute the centre of community life: echoing the voids of the tube houses, they play an important relational role and, at the same time, they contribute to internal well-being by guaranteeing ventilation and natural lighting (Fig. 8).

Fig. 8 Contemporary reinterpretations of the vernacular model: CH House, view of the front on the street, plans and section (© ODDO architects, 2019).

In addition, due to the need to have a connection with the outside through the main facade maintaining sufficient privacy for the inhabitants, the front facade is made of a perforated double skin (Fig. 8). Behind the facade there is an additional layer of vegetation, which guarantees protection from the sun and pollution, and favours natural ventilation for the entire length of the house (Fig. 9).

Fig. 9 CH House, internal photos (© ODDO architects, 2019).

Fig. 15 CH House, internal photo (© ODDO architects, 2019).

The two examples above shows how essential it is to preserve the vernacular typology as part of the cultural and historical memory and, at the same time, that it is possible to develop innovative housing models through a judicious reinterpretation of the vernacular model.

6. Conclusions

The example of Hanoi shows how important is to learn by re-studying vernacular models, specifically regarding the courtyard housing type, both in social and technological terms with the respective environmental consequences. The objectives are multiple and concern the need to deal with several urban problems — such as the management of high densities and the growing pollution due to the diffusion of modern technologies — as well as to protect the historical and traditional values.

As emerges from the previous paragraphs, the vernacular courtyard house presents, in different cultural and geographical declinations, some common characteristics and potentials that can be taken up for the definition of innovative and qualitative contemporary models, with strong consequences on housing quality and environmental impact.

With the advent of modernity and technological dominance, the control of the well-being conditions of living spaces has been increasingly delegated to technological systems that have freed architectural design from the constraints imposed by the external environment. This has come at the cost of increasing energy consumption, which has had a dramatic impact on the quality of the urban environment and on the balance of the biosphere [26]. From this perspective, it should be a primary objective of the contemporary design to promote more appropriate solutions, requestioning the relationship that links thermal and lighting comfort, energy consumption and outdoor environment learning from the ancient models.

As we have seen, contrary to recent trends, vernacular architecture has always reckoned with natural rhythms, trying to adapt the human environment to them while also exploiting their advantages. Moreover, traditional building models almost always involved the use of natural materials and local supplies. Indeed, many Oriental and Occidental vernacular courtyard house types show the ability to leverage natural resources such as wind cooling, sun heat, water and natural light, demonstrating a skilful resilience to climate change. The presence of a glazed covered central “void”, can be considered an excellent expedient to capture solar radiation, generating a greenhouse effect from which the perimeter rooms can benefit in cold periods. On the contrary, the presence of an uncovered patio with greenery and water offers the possibility to create a “passive cooling” of the interior rooms, tapping into the natural ventilation without requiring energy consumption for air conditioning [27]. An example of adaptation to the local climate is also the presence — in the Roman *domus* as well as in the Etruscan and Greek ones — of the *impluvium,* a quadrangular flat-bottomed basin designed to collect rainwater felling from the above opening on the roof (the *compluvium*). From the *impluvium* the collected water flowed into a cistern, in which it was stored for times of need. Furthermore, we illustrated that the presence of a central void entails many advantages concerning the lighting internal spaces, especially in

situations of strong urban density or problematic conformations of the lots due to stringent contextual constraints, as in the case of Hanoi.

At the same time, the patio or courtyard space represents a socially important resource, intensifying family relationships and creating opportunities for social or neighbourly exchange. Unlike the growing contemporary tendency towards individual autonomy, the vernacular habitat is based on the need for spaces to share, for places that facilitate meeting and exchange, for places that contribute to the enrichment of urban intensity. In fact, traditional ways of life seem more suitable for facilitating local solidarity, especially in contexts in which social inequalities are increasing and the question of promiscuity acutely arising.

To sum up, integrating vernacular housing principles into modern contexts poses both opportunities and challenges. Urban planners and architects can draw from the spatial organization of courtyard houses to create designs that foster community interactions while providing privacy. However, challenges include zoning regulations, property rights and the need for modern amenities that may conflict with traditional layouts. Moreover, there is a necessity to adapt these principles to suit diverse cultural and climatic contexts. This may involve reinterpreting traditional designs to meet contemporary sustainability standards and urban densities while maintaining their intrinsic value.

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