

A PERSPECTIVE ON COURTYARD DESIGN: Tulou collective housing in China

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Research Article

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Abstract

Courtyard housing, a design concept rooted in centuries-old traditions across various cultures, is widely recognized for its ability to create semi-private urban spaces within housing developments. However, the interpretation of courtyard housing varies significantly, encompassing diverse relationships between private and public spaces, shaped by cultural, traditional, and spatial mechanisms. This study explores courtyard housing from multiple perspectives, focusing on its attributes such as privacy dynamics, cultural significance, and modes of communication within and beyond the courtyard. The research then delves into the Tulou Collective Housing Project in China, a contemporary social housing prototype inspired by the traditional multi-family, fortress-like circular "earth houses" of Fujian's rural regions. By examining both the traditional Tulou and its modern adaptation, this study highlights the integration of courtyard housing principles in addressing contemporary social housing needs. The findings aim to provide insights into the opportunities and challenges of incorporating traditional courtyard housing models into modern contexts, emphasizing the cultural, social, and architectural implications. This research contributes to ongoing discussions on the relevance and adaptability of traditional housing typologies in fostering inclusive and sustainable urban living environments.

Keywords: Courtyard housing, Tulou collective housing, privacy and public space, cultural adaptation, social housing design

AVLU TASARIMI ÜZERİNE BİR PERSPEKTİF: Çin'deki Tulou Kolektif Konutları

Özet

Avlu konutları, çeşitli kültürlerde yüzyıllar öncesine dayanan geleneklere kök salmış bir tasarım konsepti olarak, konut gelişimlerinde yarı-özel kentsel alanlar oluşturma yeteneğiyle geniş çapta tanınmaktadır. Ancak, avlu konutlarının yorumu büyük ölçüde farklılık göstermekte ve kültürel, geleneksel ve mekânsal mekanizmalarla şekillenen özel ve kamusal alanlar arasındaki çeşitli ilişkileri içermektedir. Bu çalışma, avlu konutlarını çok yönlü bir bakış açısıyla inceleyerek, mahremiyet dinamikleri, kültürel anlamı ve avlu içindeki ve dışındaki iletişim biçimleri gibi niteliklerine odaklanmaktadır. Araştırma daha sonra, Çin'deki Tulou Toplu Konut Projesi'ne odaklanmaktadır. Bu proje, Fujian'ın kırsal bölgelerinde bulunan geleneksel çok aileli, kale benzeri yuvarlak "toprak evlerden" esinlenmiş çağdaş bir sosyal konut prototipidir. Hem geleneksel Tulou'yu hem de modern uyarlamasını inceleyen bu çalışma, avlu konut ilkelerinin günümüz sosyal konut ihtiyaçlarını karşılamadaki entegrasyonunu vurgulamaktadır. Elde edilen bulgular, geleneksel avlu konut modellerinin modern bağlamlara dahil edilmesiyle ilgili fırsatlar ve zorluklar hakkında içgörüler sağlamayı amaçlamakta ve bu sürecin kültürel, sosyal ve mimari etkilerine dikkat çekmektedir. Bu araştırma, geleneksel konut tipolojilerinin kapsayıcı ve sürdürülebilir kentsel yaşam ortamlarını teşvik etmedeki geçerliliği ve uyarlanabilirliği üzerine devam eden tartışmalara katkıda bulunmaktadır.

Anahtar Kelimeler: Avlu konutları, Tulou toplu konutları, gizlilik ve kamusal alan, kültürel uyum, sosyal konut tasarımı

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1. INTRODUCTION

Courtyard housing encompasses diverse typologies, each establishing unique relationships between private and public spaces. The courtyard typology of adaptability in diverse climates and cultures underscores its universality, yet modern urbanization often prioritizes profit-driven, fragmented designs over human-centered approaches. Reimagining courtyard housing in today's urban context presents an opportunity to address contemporary challenges like energy efficiency, social disconnection, and sustainability. Through this research, the Tulou Collective Housing Project in China—a modern adaptation of the traditional fortress-like Tulou dwellings—serves as a case study to explore how historical principles of courtyard living can inspire inclusive and community-oriented solutions for affordable housing. By bridging traditional design wisdom with modern needs, courtyard housing can offer innovative pathways for sustainable and socially cohesive urban living.

Courtyard housing has origins that date back centuries across various regions of the world. It is often regarded as an architectural approach that utilizes a semi-private urban space created between housing blocks. However, Humans have long sought shelter that connects them to nature, and courtyard houses have served this purpose for millennia. These dwellings feature a central open space, traditionally surrounded by rooms or walls, offering a private or semi-private area for interaction with natural elements like sunlight, wind, and plants. Originally designed for extended families, courtyard houses typically had square or rectangular layouts and low-rise structures. Over time, with the shift to nuclear family living, courtyards have evolved into shared spaces within multifamily compounds, often enclosed by low-rise apartments or detached houses. Spanning over 5,000 years, courtyard housing has appeared in at least 40 countries across diverse climates and cultures, from Asia and the Middle East to Europe, Africa, the Americas, and Oceania, in both rural and urban contexts (Zhang, 2020). The courtyard serves as a vital design element, symbolizing social sustainability and architectural excellence. Within the urban fabric, it represents a philosophical expression of social harmony and community. While the courtyard typology has been adapted and preserved in some urban morphologies, it has failed to maintain continuity in others. Over time, housing has faced various challenges, and the courtyard typology has evolved into different residential forms, often at the expense of human needs and values, driven by spatial disruptions and profit-oriented decisions (Hatipoğlu & Mohammad, 2021).

There is an important relationship between architectural layout and energy efficiency of courtyard housing. Several studies have examined in detail the impact of climatic data and orientation on the use of courtyards. For example, Aldawoud (2008) evaluated the energy performance of courtyard buildings in terms of variables such as climate, building height, glazing type and glazing percentage, while Taleghani et al. (2014) investigated the effect of vegetation and water in summer and winter with field measurements in temperate climates. Soflaei et al. (2016) analyzed traditional Iranian courtyards as a passive cooling strategy in BS climate and emphasized that orientation is critical for effective cooling. Similarly, Salameh & Taleb (2017) examined the potential of enclosed courtyards to improve thermal performance and reduce energy consumption in regions with hot climates, especially in the UAE. Dhariwal et al. (2019) analyzed the effectiveness of evaporative cooling in open courtyards in hot and arid climates such as the UAE, while Callejas et al. (2020) highlighted the potential of courtyards as a passive air conditioning strategy to improve thermal comfort in tropical climates. In this context, the use of courtyard spaces in Tulou collective housing should similarly be considered in terms of orientation and climatic impacts.

In modern urban planning, courtyard housing is revisited for its potential to foster social interaction and sustainable living. The design promotes natural ventilation and lighting, contributing to energy efficiency. Additionally, shared courtyards can enhance community bonds and provide safe spaces for recreational activities (Zhang, 2020). This observation offers an important insight into the potential of courtyard housing in modern urban planning to support social interaction and sustainable living. Indeed, the design's ability to contribute to energy efficiency by increasing natural ventilation and lighting is in line with contemporary environmental concerns (Taleghani, 2014). However, its practical implementation in densely populated urban areas raises questions due to high land costs and limited space (Carvalho & Antonio, 2017). Moreover, the claim that shared courtyards strengthen community ties depends not only on the physical design but also on the cultural and socio-economic context of the community (Hatipoğlu & Mohammad, 2021). Poorly planned courtyards can lead to privacy issues or inadequate public and green spaces, undermining the intended benefits (Ghazali, & Davis, 2005). Moreover, adapting courtyard typologies to different climates and integrating with local traditions requires careful consideration for designers and planners (Alapure, George, & Bhattacharya, 2017). Thus, while courtyard housing offers a promising solution for sustainable and community-oriented living, its implementation requires a holistic approach that takes into account economic, social and cultural dimensions as well as physical design.

In this research, for the first part, courtyard housing perspectives will be investigated as indicators considering its several attributes such as different privacy and public space mechanisms, relationship with culture&tradition, and means of communication within and outside of courtyard. In the second part, Tulou Collective Housing Project in China will be analyzed. Tulou housing project is basically a prototype for social housing -for low-income people- inspired by traditional the multifamily, fortress like circular 'earth house' in the rural areas of Fujian District. The modern prototype is a representation of the traditional one designed to enable a courtyard housing life style as social housing. This project will be examined in this research by mentioning at first the traditional one and then the modern one putting the emphasis on courtyard housing attributes of the first part. In the end, this research revealed some facts and perspectives about adopting traditional courtyard housing into our modern world emphasizing the positive and negative aspects.

2. DETERMINED INDICATORS OF COURTYARD HOUSING FOR THE ANALYSIS

The three selected indicators—Privacy Mechanism, Means of Communication, and Relationship with Culture & Tradition—are critical for analyzing courtyard housing due to their integral roles in shaping the form, function, and social dynamics of this architectural typology. These indicators not only encapsulate the fundamental principles that have historically defined courtyard housing but also provide a framework to assess its relevance and adaptability in contemporary contexts.

• *Privacy Mechanism*

The very first appearance of courtyard housing dates back to 6000s BC. in Jordan Valley. Attaining a courtyard privacy and semi-privacy was even one of the major concerns of nomadic people in Middle East by orienting the tents towards a conserved central space. In the Gulf, a similar circular orientation was made for tents to enable and organize security and privacy (Aldersley, 2014). The inhabitants of these nations tried to obtain privacy as one of their fundamental ambition and courtyard was used as a prior tool for privacy. Basically, in ancient times and nowadays, people seek protection from environmental disasters and outsider people, and the concept of privacy in courtyard housing was derived to create a control of connection between inside private and outside public area as a sequence of spaces (Nejadriahi & Dinçyürek, 2015).

Privacy in Courtyard settlements is a multi-layered design element that is provided by physical boundaries, spatial hierarchy and behavioral norms. Privacy mechanisms are a set of architectural (high walls, inward planning), vegetative (trees, hedges) and cultural (rules of use) strategies developed to protect the physical and social boundaries of individuals. Al-Hafith et al. (2017) demonstrated how high walls increase visual privacy in traditional courtyard houses in the United Arab Emirates, while Taleghani et al. (2014) documented how planting and water features provide both acoustic and psychological privacy in contemporary courtyard housing in the Netherlands. Soflaei et al. (2016) analyzed how the spatial staggering of "birun" (outside) and "anderun" (inside) regulates social privacy in traditional courtyards in Iran. Another study by Salameh and Taleb (2017) examined how courtyards enable controlled socialization in educational buildings. These studies show that privacy in courtyard design is a complex phenomenon shaped by climate, culture and function.

According to Rapoport (2007), "the form of the relation between the private and public domains — via a "lock," rather than without such a lock and with a permeable boundary — is more fundamental than the shape of the domains". In other words, the transition point is quite significant to determine privacy sequence of urban space in courtyard housing. Besides, there are two basic courtyard form typology which are the inside-out city and the houses face outward relating to directly to the street. The forms of private and public spaces may vary regarding tradition, tribe, culture, religion and the degree of modernization (Rapoport, 1977). The privacy levels of these different typologies are also different; i.e. outward facing ones have an abrupt interface from private to public, and the inside-out city ones has sequence levels from private to public which are designed to create a separate an inner life at the inside of courtyard.

Privacy has been a central concern in the design of courtyard housing since its inception. Historically, the courtyard served as a vital tool for mediating the relationship between private and public spaces, providing a controlled environment for family life and offering protection from external intrusions. This indicator is essential to explore how privacy needs influence the spatial configuration and social use of courtyards. In modern urban settings, where spatial constraints and social dynamics differ significantly, understanding the mechanisms of privacy in courtyard housing can reveal how this typology can adapt to contemporary challenges while retaining its core values.

• Means of Communication

A house reveals the social communication which determines interpersonal relationship and communication styles. It also dedicates the social network within the living environment and social class of its owner (Heathcode, 2012; Altman & Chemers, 1984). Communication in courtyard houses means the relationship between different layers of publicity and privacy hierarchy in urban space among inhabitants. This communicating behavior is determined by the form and function of courtyard sub-spaces which create interfaces between private and public domain. Rapoport (2007) considers the means communication in courtyard housing as mostly a problem. The focus on individual identity and private life rather than a community identity, although it is considered as the advantageous aspect of courtyard housing for some people, this circumstance creates problems for those forming a part of settlement fabric. This kind of self-enclosed courtyard houses own communication problems with outer environment compared to the residential units positioned on free standing houses or blocks.

Courtyard housing not only facilitates privacy but also shapes social interaction and communication within its spatial boundaries. The organization of spaces within and around the courtyard determines the hierarchy of privacy and publicity, influencing how residents interact with one another and with the broader community. Analyzing communication mechanisms within courtyard housing is crucial for understanding how it fosters or inhibits community bonds and how these relationships can be reimagined in modern designs to promote social sustainability.

• Relationship with Culture&Tradition

The cultural and traditional context of courtyard housing is deeply embedded in its architectural and social fabric. This indicator examines whether the essence of historic courtyard typologies can be preserved or adapted in contemporary applications, considering evolving cultural practices and urban lifestyles recreation (Zhang, 2020; Land 2004). By exploring this relationship, the analysis highlights the extent to which architectural design can accommodate cultural continuity while addressing modern needs such as sustainability, density, and inclusivity.

In this research, what is meant by the relation with culture&tradition is whether re-implementation of a historic traditional courtyard structure can (need to) maintain its original habits in the contemporary one or not. This topic also analyzes the relationship between dwelling culture and courtyard physical form questioning whether this relationship is controllable through architectural design or not.

3. AIM AND METHOD OF ANALYSIS

The aim of this research is questioning the adaptation of traditional courtyard housing into current architectural implementation upon an example from China, Tulou Collective Housing Project by determining some facts and perspectives. In this research, sequence of analysis is firstly literature review on courtyards to determine specific indicators to question the implementation of traditional courtyard design into current modern world, explaining the Tulou project to reveal a specific case to achieve the aim of research, and finally addressing some questions to project regarding the indicators at the first part to bring the Tulou project and traditional courtyard implementation to today's world up for discussion in order to contribute the progress of research.

This study adopts a desk research methodology, utilizing existing literature and secondary data to analyze the Tulou housing example within the broader context of courtyard housing. The research relies on peer-reviewed articles, books, and case studies. The sources referenced in this study were selected according to certain criteria. First of all, studies that directly address the physical, social and cultural dimensions of courtyard housing were preferred. In order to ensure chronological balance, studies published between 2008 and 2023 have been selected in order to address both the basic theoretical framework and current practices together. This approach allowed for an examination of the historical development of the subject as well as its current reflections. When the chronological distribution of the sources is examined, it is seen that the study is largely supported by current literature. Approximately 65% of the sources were published between 2010-2019, and 8 sources from the last five years show that the study has caught up with the current debates. A balanced distribution has been achieved between classical studies before 2008 (Rapoport, 1977; Altman & Chemers, 1984), which form the theoretical basis of the study, and post-2013 sources (Lin, 2013a; Lin, 2013b, Urbanus, 2008), which address current practices. In particular, studies from 2020-2021 (Callejas et al., 2020; Hatipoğlu & Mohammad, 2021) expanded the scope of the research by addressing the topic from multidimensional perspectives such as sustainability and community life. This comprehensive and balanced selection of sources enabled the study to cover both historical continuity and current architectural debates, thus enabling a holistic examination of the theoretical and practical dimensions of the subject.

The aim is to examine the architectural, social, and cultural dimensions of courtyard housing, focusing on three key indicators: privacy mechanisms, means of communication, and the relationship with culture and tradition. The Tulou housing example, as a traditional and contemporary manifestation of courtyard housing, is analyzed through a qualitative synthesis of available data, emphasizing its architectural adaptations, cultural continuity, and social sustainability. This method allows for an in-depth exploration of the selected indicators by leveraging the wealth of knowledge in academic and professional sources, ensuring a comprehensive and critical assessment of the subject. By examining the Tulou example through existing resources, the study aims to draw meaningful insights into the integration of traditional courtyard housing principles into contemporary design practices.

These three indicators were chosen because they represent the multidimensional nature of courtyard housing, encompassing physical, social, and cultural aspects. Privacy Mechanism addresses the spatial and functional design, a fundamental aspect of courtyard housing's success across diverse regions and eras. Means of Communication focuses on the social dynamics within the courtyard, revealing how this housing typology fosters or limits community interaction. Lastly, the Relationship with Culture & Tradition bridges the past and present, enabling a critical examination of how traditional designs can inform contemporary architectural practices. Together, these indicators provide a comprehensive framework for analyzing courtyard housing as a resilient and adaptive model in urban environments.

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Although enriching this research with field visits and on-site observations would have added significant depth, the methodological feasibility of conducting user interviews was constrained by access limitations, ethical considerations, and the need for a sufficiently representative sample. Tulou communities exhibit diverse social structures, requiring extensive fieldwork and long-term participant observation to ensure a comprehensive and unbiased analysis. Additionally, previous studies have demonstrated that spatial and visual analyses, combined with a literature-based approach, provide valid insights into collective housing dynamics. Despite the inability to examine this case within its native context, this study contributes to the discourse through a detailed desk-based analysis, establishing a foundation for future fieldwork-based investigations.

The research findings were structured and examined through two main question sets, each accompanied by predetermined research-questions derived from the literature review and study outputs. These questions guided the analytical framework of the study:

Q1. What are the basic features of the privacy mechanism in traditional Tulou houses and its contemporary adaptation?

- If the modern collective housing project of Tulou is considered together with its surrounding socio-economic context, does the increase in privacy in such a courtyard housing make the environment more socially sustainable or not?

Q2. Can the re-implementation of Tulou's historic traditional courtyard structure in the contemporary project reflect the cultural and traditional characteristics of the old one?

- Is the relationship with culture and tradition controllable through architectural design or not?

These focused inquiries aimed to uncover the architectural and social dynamics of Tulou's transformation from a traditional to a contemporary setting, enriching the discourse on courtyard housing within modern urban contexts.

4. TULOU COLLECTIVE HOUSING PROJECT

The Tulou has a long history as an integral part of the Hakka people's traditional settlement patterns in China. These structures were not just designed for protection but also played a central role in fostering social connections, cultural identity, and economic activities. Located primarily in the Fujian province, especially in the Wuyi Mountains, these buildings were constructed by the Hakka people who had migrated from northern China. The circular form of the Tulou, initially designed as a defence mechanism against external threats such as wild animals and intruders, also functioned to bring people together within a communal setting. The architectural approach of Tulou project is originally a courtyard housing dwelling unit specific to Hakka people as a communal composition of residential units (Urbanus, 2008). In this analysis, Fujian Tulou is used to refer traditional living house in Fujian for Hakka people as a specific community established between 13th and 20th Century as a multi-storey living settlement made of clay. As a result of migration to north China, many of them were Hakka people, Wuyi Mountains were inhabited by constructing these circular settlement units. The ancient circle shaped courtyard houses were enclosed with fortified buildings to protect themselves from external dangers such as fierce animals and thieves (Figure 1). The Tulou is considered as the largest, developed in terms of defense village residences in history (Knapp, 2000).

These buildings' evolution is linked to the Hakka people's shift from a nomadic lifestyle to a more permanent settlement. The defensive qualities of the Tulou, with its round shape, served as protection from potential threats, but it also contributed to creating a cohesive community. Rapoport (2007) emphasizes that the sustainability of traditional societies is not merely a product of the built environment but also the social dynamics nurtured by these spaces. The Tulou was, therefore, not just a shelter but a place that strengthened social and cultural ties among its inhabitants.

Fujian Tulou houses provide a strong defense with their thick earthen walls and single entrance, while at the same time offering an equal and solidary community life inside. These huge circular or rectangular structures are designed to accommodate the entire clan. In contrast to the austere, closed-in exterior, the equally sized rooms, communal living spaces and ornaments arranged around the inner courtyard reflect the social values of Hakka culture. These self-sufficient structures are both a protected fortress and a harmonious communal living space (ArchEyes-Timeless Architecture, 2024)

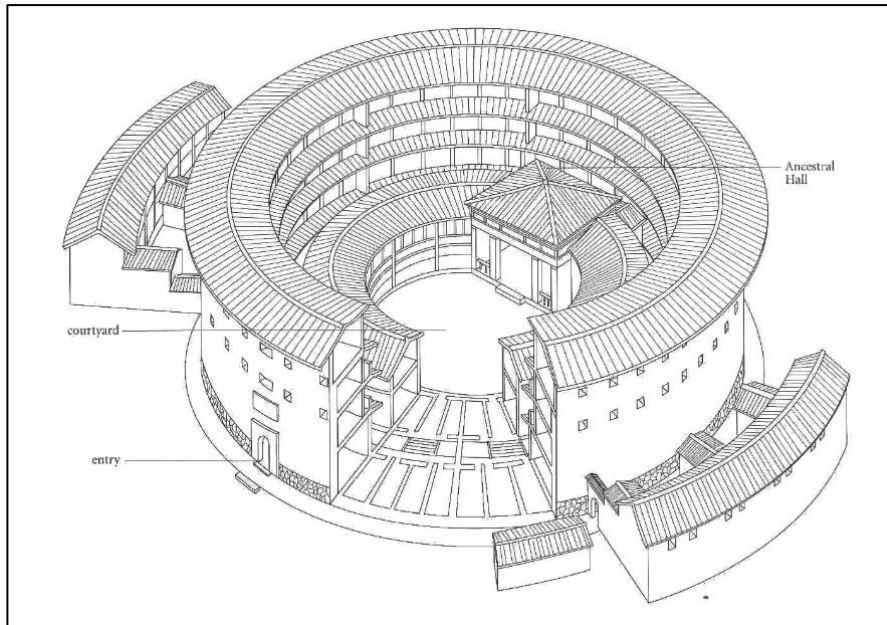


Figure 1. The unique design of Fujian Tulou (Senses Atlas, 2020)

The social framework of the Tulou and its architectural design illustrate how traditional societies embedded social interaction into their built environment. With their communal spaces, the traditional Tulou serves as a model for modern socially sustainable living (Figure 2). Furthermore, these structures offer valuable insights into how traditional buildings can guide contemporary sustainable architecture (Carvalho & Antonio, 2017). The historical significance of Tulou highlights the potential of these structures to inspire socially and environmentally sustainable housing solutions today.



Figure 2. Fujian Tulou for Hakka People in China as the inspiration for contemporary courtyard housing in China (Lin, 2013b)

The adaptation of Tulou structures in contemporary collective housing goes beyond just replicating its historical form. It seeks to retain and reinterpret the social and cultural values embedded in the original structures. Thus, integrating the traditional Tulou design into current housing developments is seen as a means to preserve cultural heritage while addressing contemporary needs. In today's design practices, creating a balance between privacy and communal interaction has become a critical concern. Therefore, the re-imagining of the Tulou is not only about maintaining its physical appearance but also about ensuring its cultural sustainability (Zhang, 2020).

One of the iconic examples of modern Tulou houses is the 'Social Housing in Guangzhou' project designed by Urbanus Architecture (team led by Meng Yan, Liu Xiaodu, Wang Hui). The design team reinterprets the circular form and community-oriented spatial organization of traditional Chinese Tulou with reinforced concrete building systems and contemporary materials. The project meets the need for high-density urban housing while providing shared courtyards and communal spaces that strengthen neighborhood cohesion (Urbanus, 2008).

The modern project is called 'Tulou Collective Housing' established in Nanhai, Guangdong/China. The migrant population to Guangdong increased the real estate prices in the district which made owning or renting a residential unit difficult for the new comers and existing inhabitants. Therefore, local policy makers came up with a creative solution as a pioneer alternative to China's contemporary housing which is Tulou Collective Housing Project. Figure 3 demonstrates a visualization of the proposed settlement that had not built, yet. The social class target of this project is low income people as social housing. The architectural design of residential blocks is as fortified circular blocks having 7-storey. There is also a roof garden and a square shaped courtyard inside the block as a communal semi-private space. Geometric layout of architectural design consists of an outer circle and inner rectangular block, connected by bridges to each other. The space left in between these outer and inner blocks, corridors, bridges, terrace and middle square are also in communal use of courtyard inhabitants as interaction spaces. The project is inspired by traditional Tulou Housing in rural areas of Fujian province. This social housing project also includes living, storage, shopping, religious amenities, and public entertainment facilities within a single circular outer shaped building block entity. The design philosophy of new social housing project was mentioned as "closed

outside, open inside". The main distinction between vernacular Tulou design and new modern design as courtyard housing is related to climate sensitivity. Fujian traditional Tulou has few windows to disable the penetration of sun into block and smaller courtyard with thick walls due to longer summer season (Carvalho & Antonio, 2017; Aldersley, 2014). On the other hand, the contemporary courtyard implementation project in Guangdong gives extra living spaces to inhabitants by the addition of balconies to each residential unit. For most of the observers, the project is considered as successful since it addresses how an old vernacular architectural design can reveal inspiration for modern low income housing (Lin, 2013a).



Figure 3. The design of contemporary Tulou setting (Lin, 2013b)

Figure 4 reflects the spatial organization and layout approach of the contemporary Tulou housing project. In reference to the inward-oriented courtyard structure of traditional Tulou, the residential units are organized around a central courtyard. Along with the high-density residential blocks and social spaces, the image also clearly shows the controlled entry and exit points that prioritize security and privacy. While harmonizing with the surrounding urban fabric, this layout limits social interaction to the inner courtyard and offers a living space that is physically separated from the external environment. This suggests that contemporary Tulou creates a more individualized and closed community structure compared to its traditional counterparts.



Figure 4. Contemporary Tulou settlement plan and spatial organization (Urbanus, 2008)

Figure 5 presents a general layout of outer circular, inner rectangular blocks, and courtyard in the middle. It illustrates the architectural layout of the Tulou Collective Housing project, featuring the relationship between the outer circular structure and the inner rectangular block. The design is centered around a shared courtyard, providing a communal space for residents. The outer circle encircles the inner rectangular block, creating a boundary that separates private and shared spaces. The courtyard, positioned in the center, fosters interaction among residents while maintaining privacy and promoting social engagement.

Figure 6 is a view from corridors as one of the communal interaction spaces. This figure shows the perspective from one of the corridors of the building, which serves as a communal space for the residents. The corridors play a key role in encouraging social interaction by connecting different sections of the building. The layout allows for both privacy and opportunities for community engagement. The view emphasizes the open and accessible nature of the corridors, which facilitate casual meetings and interactions among residents.



Figure 5. General layout of outer circular, inner rectangular blocks and courtyard in the middle (Urbanus, 2008)



Figure 6. View from corridors as one of the communal interaction spaces (Urbanus, 2008)

Figure 7 shows bridges as common spaces within building block. The figure highlights the bridges connecting the inner circular and/or inner rectangular blocks of the building. These bridges are integral to the design, acting as both functional passageways and shared spaces for the residents. The bridges provide a sense of connection within the building and promote social interaction by allowing easy movement between different areas. They contribute to the communal atmosphere of the Tulou Collective Housing, offering space for residents to meet and engage informally.



Figure 7. Bridges as common spaces within building block (Urbanus, 2008)

Figure 8 presents the main and only entrance of the courtyard. The entrance serves as the central access point for residents and visitors, marking the transition from the public to the private domain. It is a crucial element of the design, guiding movement into the inner communal spaces while maintaining security and privacy for the inhabitants. The simplicity of the entrance reflects the project's functional focus, while the surrounding structure emphasizes its enclosed and protective nature.



Figure 8. The main and only entrance of courtyard (Aaberg-Jørgensen, 2011)

Figure 9 presents the façade with balconies. This figure demonstrates the prominent balconies attached to each residential unit. The balconies are a key element of the modern adaptation, providing additional living space and extending the residents' private domain. The façade reflects the contemporary interpretation of the traditional Tulou design, blending historical influences with modern requirements. The inclusion of balconies offers a connection to the outdoors, contributing to the overall livability of the spaces.

Figure 10 presents the view from the street and the fenced surrounding of the courtyard. The fence acts as a boundary between the public street and the private courtyard, reinforcing the sense of security and separation. The design of the fencing reflects the project's focus on providing a protected and controlled environment for residents, while still allowing for openness and social interaction within the inner courtyard. The outer view highlights the contrast between the public exterior and the private, communal space within.



Figure 9. Façade with balconies (Aaberg-Jørgensen, 2011)



Figure 10. View from the street and fenced surrounding of courtyard (Aaberg-Jørgensen, 2011)

In summary, the Tulou Collective Housing project exemplifies a harmonious blend of traditional architectural principles and modern design requirements, as illustrated in Figure 4 to Figure 10. The layout, with its outer circular and inner rectangular blocks centered around a shared courtyard, fosters a balance between privacy and communal interaction. Communal spaces such as corridors and bridges encourage social engagement while maintaining functional connectivity within the building. The main entrance serves as a symbolic and practical transition point, emphasizing security and privacy. The inclusion of balconies extends residents' private domains and enhances livability, while the fenced courtyard reinforces the boundary between public and private spaces. Together, these elements create a cohesive living environment that prioritizes both individual well-being and community interaction, reflecting the project's innovative adaptation of the traditional Tulou design.

5. RESULT AND DISCUSSION

Based on the outcomes and interpretational analyses, it can be concluded that the Tulou Collective Housing Project is a subject with both debatable and criticizable aspects, while also offering notable positive contributions. The design, inspired by traditional Tulou structures, contributes to the modern concept of social housing but also reveals certain limitations and challenges. In this context, the relationship between historical heritage and modern adaptation emerges as a topic worth examining from both structural and socio-cultural perspectives.

To conclude the research, the analysis is elaborated through questions regarding different perspectives from pre-determined three indicators of courtyard housing. The first question focuses on the key privacy features found in traditional Tulou houses and examines how these elements have been incorporated or modified in the modern design. The second question explores the degree to which the cultural and traditional aspects of historic Tulou structures have been maintained or transformed within the context of contemporary architectural practices. These inquiries serve as a basis for assessing the project's effectiveness in connecting historical architectural traditions with modern housing solutions. In this respect, two main questions are mentioned to conclude the discussion as follows.

- *What are the basic features of privacy mechanism in traditional Tulou houses and its contemporary adaptation?*

--If modern collective housing project of Tulou is considered together with its surrounding socio-economic context, does the increase in privacy in such a courtyard housing make the environment more socially sustainable or not?

Firstly, in each project privacy mechanisms are established with separate living units adjacent to each other within courtyard. In traditional Tulou housing, middle courtyard, transition corridors and spaces, and communal storage rooms inside the building were used as places other than private spaces of individual entities. Although the privacy mechanism in traditional Tulou reflects a private defense to outside externalities because of security reasons, a sort of communal life and semi-privacy was provided inside the courtyard. As in the traditional Tulou, in the contemporary public housing project, private life continues within individual living units. Different from traditional one, private living units are not shared with other persons; that is, a living unit is considered as completely private and it is isolated from semi-private and semi-public life of courtyard housing. Inside the courtyard, there are middle court, corridors between set of single living units and bridges between structural parts of building which are semi-private and semi-public spaces. As in traditional one, the social life is almost segregated from the outside environment and its sociality by the existence of a locked gate which can only be opened to residents of courtyard housing and their pre-allowed guests.

Tulou project was positioned to an area close to city center; thus, high-rise offices and prestigious residences are seen at the surroundings. The population living in contemporary Tulou project consists of laborers and low-income workers which puts forth the socio-economic differentiation. In this project, privacy within courtyard is increased between individuals through creating a sort of gated community with a controllable entrance against outside environment. Regarding the correlation between the old and new Tulou designs, whilst the old one was a fortified one to be protected from enemy attacks and fierce animals, the new Tulou project has been strictly enclosed against the outside social life.

Consequently, being completely gated makes contemporary Tulou project more socially exclusive. In other words, in social aspect, this project created alienation to outside environment for the residents of Tulou project since it provides almost all the residents need for living inside the courtyard block. Therefore, what makes the project more socially-unsustainable is focusing intensively on privacy of community and individuals living inside, because this project makes any difference from prestigious gated-communities in terms of social inclusion and privacy.

- *Can the re-implementation of Tulou historic traditional courtyard structure in the contemporary project reflect cultural&traditional characteristics of the old one?*

--Is the relationship with culture&tradition is controllable through architectural design or not?

The cultural-traditional identity of the old Tulou houses consists mainly of living a communal life inside the block. The residents of traditional Tulou were sharing almost all they have as goods and other things to sustain their life. They had common storage for foods and collective work inside the block was quite prominent. Their tradition was established upon staying and acting together to have a better life quality and to protect themselves from externalities. In the new Tulou design, many of those traditional characteristics have changed. They do not share with each other or act together anymore in the new courtyard block. The only fact remained as the thing that they share is the communal spaces as middle court and corridors-bridges. However, it is obvious that the historicity contexts of these two projects are completely different, and one cannot expect to observe these two projects as traditionally same. Nevertheless the architect of the contemporary design tries to reflect cultural aspects of the old Tulou design. The architectural principle of 'e-shaped loop' was kept, and architectural design achieved to insert that many of residents on a relatively small land by making them benefit from communal rights and, sun and residing advantages equally. Architectural design also achieved to provide various residential unit types to low-income workers, which is not commonly seen in parts of cities. In addition, architectural design achieved to keep a communal social life inside the court as in the traditional one.

The analysis of the contemporary Tulou Collective Housing project highlights a multifaceted approach, encompassing both the challenges and advantages of reinterpreting traditional designs in a modern socio-economic context. The findings lead to two significant discussions that underline the complexity of such adaptive reuse projects.

The first discussion centers on the balance between privacy and social sustainability. The privacy mechanisms in the contemporary Tulou design—achieved through physical enclosure and limited external interaction—have unintentionally resulted in social exclusivity. While the enclosed courtyard fosters a sense of security and community within, it alienates residents from the broader urban environment, creating a gated-community dynamic. This dynamic undermines the original Tulou concept of inclusivity and social cohesion, shifting the project's social impact toward unsustainability by restricting engagement with the outside world. The second discussion focuses on the cultural and traditional continuity of the design. Although the architectural layout reflects some cultural elements of the historic Tulou, such as the communal courtyard and the 'e-shaped loop' structure, the fundamental communal practices of the traditional Tulou—such as shared goods, collective work, and deeply interconnected social bonds—are absent in the contemporary version. This reflects the difficulty of preserving intangible cultural heritage through architectural design alone, especially when the socio-historical context differs significantly from the original.

Table 1 summarizes how traditional Tulou housing and contemporary Tulou public housing projects differ socially, culturally and architecturally. While the traditional Tulou emphasizes collective living and social solidarity, the contemporary version offers a more individualized lifestyle. In contemporary Tulou design, where privacy is increased, interaction with the external environment is limited and a "gated community" approach is adopted with controlled entry and exit mechanisms. This situation, although architecturally referencing traditional forms, brings some shortcomings in terms of social sustainability. By revealing the basic dynamics of this transformation, the table provides an important basis for discussion on how cultural continuity and social inclusiveness should be balanced in modern housing projects.

Table 1. Morphological and spatial comparison of traditional and contemporary Tulou housing

| ASPECT | Traditional Tulou Housing | Contemporary Tulou Collective Housing Project |
|---------------------------------|---|--|
| <i>Privacy Mechanism</i> | Private living units adjacent to each other within a courtyard; communal storage and shared spaces inside the building. | Private living units are completely isolated from others; controlled access creates a gated-community effect. |
| <i>Communal Spaces</i> | Middle courtyard, transition corridors, and communal storage rooms foster a semi-private, communal lifestyle. | Middle courtyard, corridors, and bridges exist but do not foster communal sharing as before. |
| <i>Security & Enclosure</i> | Fortified for defense against enemy attacks and wild animals. | Gated entrance strictly limits external interaction, leading to social exclusivity. |
| <i>Social Interaction</i> | Strong communal life; shared goods and collective work sustain the community. | Social life is limited inside the block, reducing community interaction and engagement with the outside world. |
| <i>Socioeconomic Context</i> | Historically designed for agricultural and rural communities sharing resources. | Houses low-income laborers, but social segregation occurs due to controlled access and self-sufficient design. |
| <i>Cultural Identity</i> | Deeply interconnected social bonds; shared traditions and practices. | Cultural references exist in architectural form but lack traditional communal behaviors. |
| <i>Architectural Design</i> | 'E-shaped loop' structure optimizing sunlight and shared space usage. | Maintains 'E-shaped loop'; efficient land use but with modern privacy and housing considerations. |
| <i>Urban Integration</i> | Traditionally located in rural areas, fostering close community ties. | Situated in an urban area near high-rise offices, intensifying socio-economic differentiation. |
| <i>Social Sustainability</i> | Inclusive and cohesive social structure based on collective living. | Privacy-focused design fosters alienation, limiting broader social sustainability. |
| <i>Conclusion</i> | Highly communal and socially inclusive, preserving traditional ways of living. | Architecturally functional but raises concerns about social isolation and lack of true communal spirit. |

In conclusion, the new Tulou re-implementation project can be considered as effectively working in terms of architectural design and physical space use. However, there are still questionable areas in the new design in terms basically of communication between individual, and communication of community living inside the block with outside environment. The fear of social segregation of courtyard houses as small set of communities have the possibility to come off with the existing understanding of this type of architectural design. The contemporary Tulou project reveals both successes and shortcomings. It demonstrates the potential of reimagining vernacular architecture to address modern housing challenges, particularly for marginalized populations. However, it also underscores the risks of prioritizing privacy and architectural preservation without adequately addressing social inclusivity and cultural authenticity. These findings emphasize the need for future projects to adopt a more integrated approach, balancing privacy, social sustainability, and cultural continuity to foster a more holistic and inclusive living environment.

This research not only examines the transformation of architectural forms, but also explores the effects of this transformation on social sustainability. The transformation of the traditional Tulou's structure based on solidarity and collective living into a spatial organization focused on social isolation and privacy in its contemporary version is important in terms of showing how housing typologies are affected by the socio-economic context. Especially when the interaction of factors such as urban dynamics, sociological factors and economic modernization are taken into consideration, it is seen that the subject is highly suitable to be deepened with comparative analyses. In this context, it is suggested that the effects of lifestyle changes on spatial organization, the role of economic factors in housing transformations and cross-cultural comparisons of housing adaptations with courtyards, which have not yet been fully examined, can be discussed in future studies. The study emphasizes that contemporary housing projects should be evaluated not only by physical design criteria, but also by social interaction patterns, cultural continuity and urban integration. Moreover, by highlighting the growing social exclusion caused by gated communities, it offers a fresh perspective on how the balance between privacy and community life can be achieved in contemporary urbanization models.

Declaration of Research and Publication Ethics: This study which does not require ethics committee approval and/or legal/specific permission complies with the research and publication ethics.

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