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VERNACULAR VERTICALITY AND SPATIAL PRAXIS: A SOCIO-SPATIAL ANALYSIS OF TRADITIONAL TOWER HOUSES IN THE OLD CITY OF SANA'A, YEMEN

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Abstract:

The layout of traditional tower houses in the Old City of Sana'a, Yemen—a UNESCO World Heritage site—shapes and reflects local socio-cultural traditions. Drawing on socio-spatial theory and vernacular architecture discourse, the study views these four- to seven-story structures as dynamic frameworks where cultural values, social hierarchies, and everyday practices are physically expressed. Specifically, the research investigates the two-way relationship between domestic life and vertical zoning, focusing on spatial hierarchies, privacy gradients, gendered domains, and the integration of communal activities within a dense urban fabric. Using a qualitative case study methodology, the study analyses the Bait *Abu Luhum* tower house in the *Al-Abhar* district. Data collected through architectural documentation, direct observation, semi-structured interviews, and surveys enable a multi-layered analysis of both spatial form and lived experience. The findings reveal that the tower house's spatial logic embodies a culturally embedded system that seamlessly negotiates privacy, social interaction, and environmental adaptation.

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Its vertical arrangement reflects a nuanced socio-cultural ordering, using architectural elements to mediate between public and private realms while reinforcing collective identity and household structures. By situating the tower house within broader debates on spatial production and vernacular sustainability, this study demonstrates how indigenous architectural knowledge can inform contemporary design. Ultimately, it argues for context-responsive, culturally grounded spatial strategies to address modern challenges in housing and urban development.

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Keyword:

Old City of Sana'a, Tower Houses, Traditional Housing,
Vernacular Architecture, Yemen



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Introduction

In the region Islamic, most of the study wish to complete the Islamic essence and lifestyle in a better environment within the urban community. However, the normal lifestyle in Islam fixing to the socio-economic, and values community in Islam world. The nature of environment is fragment of the strains in Islam to build a magnificent Islamic state in the scope of built environment and engineering (Saoud, 2017).

Traditional Yemeni tower houses are renowned for their multi-story construction and visually striking ornamentation. Typically exceeding five stories, these structures frequently reach seven, eight, or even nine stories in larger builds. The panorama of Old Sana'a—where hundreds of these high-rise dwellings rise above the ancient city walls—creates an unforgettable visual landscape. Functionally designed to support extended familial networks, these tower houses historically accommodated a primary family unit alongside two or three closely related families living under a single roof. Sustainability is deeply rooted in Islamic tradition, offering a comprehensive framework that integrates economic vitality, social responsibility, environmental stewardship, biodiversity preservation, and human values (Abdussamad, 2021).

This research examines traditional Yemeni architecture by analysing spatial layouts and house designs within the Old City of Sana'a, focusing specifically on the iconic tower house. It investigates how spatial organization and floor plans reflect the daily routines, needs, and cultural traditions of Yemeni society. Each level of the tower house accommodates specific social, familial, and religious activities, illustrating the profound influence of traditional architecture on the daily lives of its inhabitants (Al-Thahab & Mushtaha, 2018).



Figure 1: Main Gate (Left) and Tower Houses (Right) in Old City Sana'a

Source: (Abu Bakar, 2025)

This study focuses on how daily, social, and cultural practices shape the spatial organization of traditional tower houses in the Old City of Sana'a. The scope is specifically limited to floor-by-floor space arrangements and does not extend to structural components or building materials. Furthermore, the analysis examines how vertical space allocation aligns with specific human activities across each level. As illustrated in Figure 2, space planning is directly influenced by three core pillars of Yemeni lifestyle: religious, social, and cultural activities.

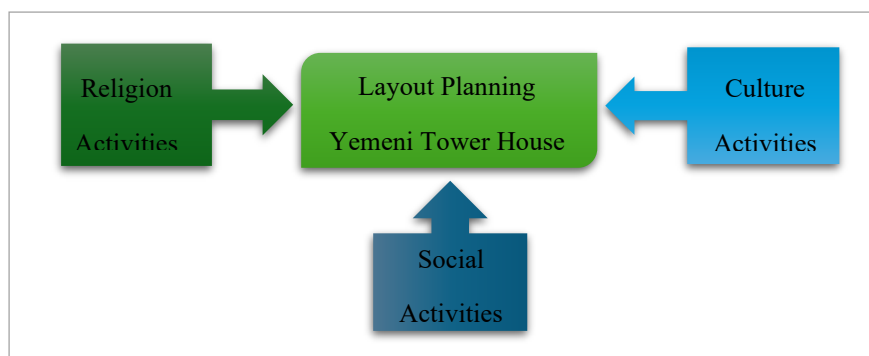


Figure 2: Socio-Functional Activity Categorization Within Traditional Tower Houses

Source: (Abu Bakar, 2025)

Research Methodology

Adopting a case study design, this research investigates the privately-owned Abu Luhum tower house in the Old City of Sana'a. Data collection involved a multi-method approach, combining in-depth structured interviews with subject-matter experts, on-site architectural observations, precise spatial measurements, and secondary data obtained from the house's residents.

The research methodology adopts a threefold approach to data collection and analysis. First, primary data is gathered through field observations, and targeted respondent interviews. Second, secondary data is drawn from a comprehensive literature review encompassing academic books, journal articles, web publications, magazines, and local newspapers. Third, a field case study of a traditional tower house in Old Sana'a provides empirical architectural data.

The collected information is evaluated using both qualitative and quantitative analytical techniques.

Traditional Yemeni Tower House

The multi-story tower house represents the predominant residential typology in the Old City of Sana'a. These tall, square-plan structures feature vertical construction that culminates in a specialized reception and social hall (*mafraj*) on the top floor. Every level in the tower houses has different purpose according to the activities in the space by family members. There are different sizes of area particularly the types of activity in the space. However, some of these domestic spaces have become insufficient to meet the family's growing needs. Figure 3 shows the entrance of Old City Sana'a gate (left side) and the sectional of tower house (right side). As mentioned by Soltanzadeh and Moghaddam (2015), three architecture characteristics is placed at the eastern part of Sana'a with numbers of mosques and shops in the meantime, the palace and gardens are positioned in the central of the city. However, at the western part the Jewish people is divided in the two parts with two different gates. Generally, the floor designed with eight or nine level, but the typical building floor is about five floors.

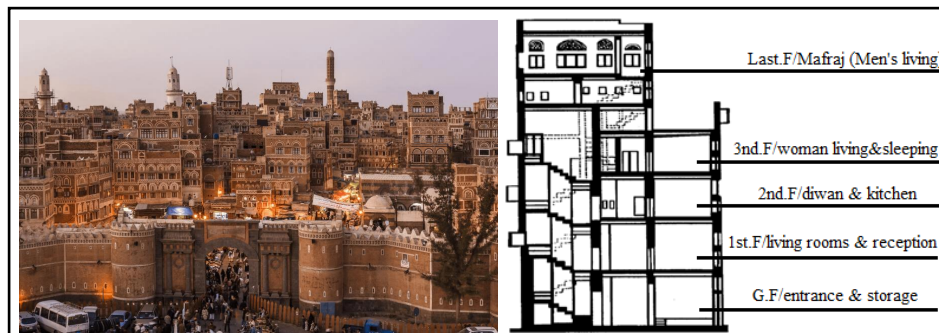


Figure 3: Old City Sana'a (Gelbart, 2021) And Sectional of Tower Houses

Source: (Al Sayyed, 2012)

The towers are the main elements in the Old City of Sana'a, which is important characters in the city. The buildings were built with the accent like opening space to show the synchronization with the surrounding of nature and the buildings were built with the 4 to 9 levels by the requirement of space (Al-Taher Engineering Consulting Centre, 2005).

The perpendicular construction with arrangement multi-storied spaces shows the conversion spaces from public to private area. Mostly, the lower floor and mezzanine are designing for animals' place and the storage, fruit, and grain, and the small space functionally for dry ordure from the bathrooms above.

The second floor marks the primary transition into the home's active zones and serves as the reception level for visitors, anchored by the public sitting room, or *diwan*. Characterized by a rectangular layout, the *diwan* features a flexible, multi-functional furnishing typology typical of Yemeni domestic spaces—equally accommodating dining, socializing, sleeping, or a combination of all three. Cushioned seating lines the perimeter of the walls, defining a narrow, central carpeted corridor and leaving a dedicated space near the entrance for shoe removal. To accommodate a seated posture, the windows feature low sills and are composed of two distinct vertical elements: the lower openings feature operable wooden shutters optimized for climate

control and ventilation, while the upper arched or circular transoms guarantee continuous daylighting when the lower shutters are closed.

The spaces are surrounding by environmental lifestyle and culture of Yemen accent contrasted in different culture from different region, by divided the type of activities in space and social economic from one region to another (Al-Shawash & Muhammad Ali, 2007). Basically, the Yemeni traditional houses were classified into four types building and architecture, which is shown in Table 1.

Table 1: The Activities for Each Level in Tower House

No	Classification of Yemeni Houses	Explanation	No	Classification of Yemeni Houses	Explanation
1.	Primitive houses (reed huts) 	These single-story dwellings comprise living quarters, livestock shelters, and storage areas; they typically lack wall windows, relying instead on ceiling openings for ventilation.	3.	The multi-story house (Tower House) 	It incorporates all the features of other traditional house types, making it the essential Yemeni home. These tower houses typically stand at least five stories high, with some extending up to eight or nine stories.
2.	Reed huts in the Tihama region 	Built of stone and blocks, the house features an external staircase accessing the living areas on the upper two floors. The ground floor is used for housing livestock, while the kitchen and toilets are generally located outside the home.	4.	The Oldest Skyscraper, Shibam Yemen 	Rising dramatically from the cliff edge of Wadi Hadramaut, the 16th-century walled city of Shibam features a dense cluster of multi-story tower houses constructed entirely from sun-dried mud brick and clay.

The upper window openings incorporate *takhrim*—elaborate gypsum tracery—fitted with either coloured glass or thin, light-diffusing alabaster panels known as *qamariya*. Importantly, the clearness of the *qamariya* diffuses a soft, yellowish-brown glow, whereas the vibrant patterns of the *takhrim* project an energetic role of coloured light across the interior surfaces. The verticality of the spaces is further expressed by decorative bands and high, unreinforced gypsum plaster shelving units used for the display of personal items and cultural artefacts.

Serving as the primary family *diwan*, the third floor is dedicated to major ceremonial events such as births, weddings, and funerals. The levels immediately above house semiprivate living spaces alongside the kitchen, which is strategically positioned just below the topmost floor to facilitate service across both upper and lower levels.

This upper floor functions as the domestic centre for women. While they retain access to the entire residence, this zone contains the kitchen and an adjoining outdoor terrace protected by high, screened parapets that allow women to view the surrounding neighbourhood without being seen. Fuelled by wood, the traditional bread ovens frequently leave the kitchen interior smoke-blackened, with emissions venting through perforations engineered into the exterior wall.

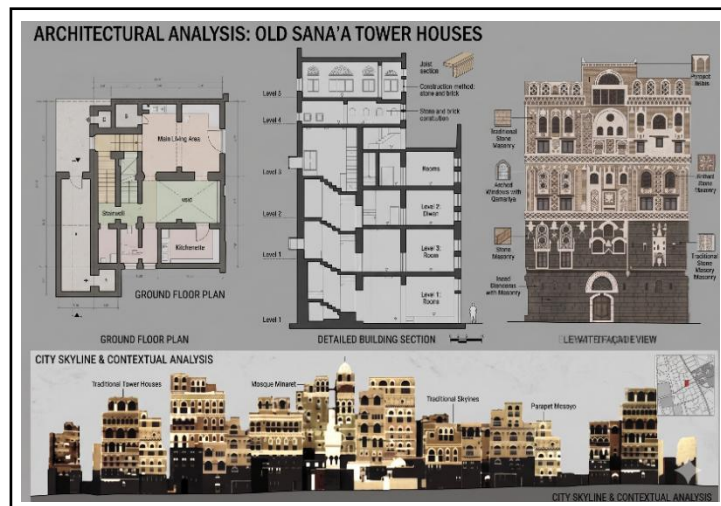


Figure 4: Architectural Analysis Building Structure

Source: (Al-Taher Engineering Consulting Center, 2005)

Based on the building's apex, the highest level is dominated by the *mufraj*—an exclusive, highly ornamented reception room reserved for family members and distinguished guests. This space serves as the primary arena for afternoon social rituals, predominantly male-centric gatherings centred around conversation, poetry, 'ud music, water-pipe smoking, and *qat* chewing. Architecturally, the *mufraj* represents the pinnacle of the tower house's decorative and spatial hierarchy; its elevated positioning maximizes panoramic vistas of the urban landscape, while upper *takhrim* (stained-glass) windows project a dynamic play of shifting, coloured shadows that heighten the sensory experience of the afternoon social sessions.

Structurally, the tower house is organized around a monolithic central staircase that acts as both the vertical circulation core and the primary load-bearing spine of the building. This architectural configuration is paired with substantial stone, and masonry envelope walls whose high thermal mass induces a significant thermal lag, successfully dampening diurnal temperature fluctuations. Passive microclimate control is further regulated by *shubaq*—projecting masonry cooling boxes integrated into the staircase walls and floor lobbies to facilitate continuous, evaporative cross-ventilation.

Traditional Tower Houses Characteristics

The architectural feature of the tower houses is obviously their height character. This is outstanding the non-existence of space surrounding of old city as well as to arable land. Furthermore, it is related to the city's ancient vulnerability to competitor attacks. Due to political instability and geopolitical vulnerabilities, the lower levels of these dwellings were engineered for defence. Consequently, ground floors remained uninhabited, while the story

directly above was typically utilized for bulk storage. The traditional architecture of Sana'a, Yemen, is a masterclass in adapting to climate, social needs, and religious requirements. Each house type you mentioned reflects a specific urban context and lifestyle. There are three characteristics of traditional houses:

Table 2: Tower House Characteristics

No	Types of Vernacular Houses	Descriptions	Elements	Descriptions
1.	The Traditional houses.	The traditional house is the quintessential image of Old Sana'a. These structures can reach heights of 5 to 9 stories and are built to maximize space on narrow plots within the dense walled city.	Vertical Zoning	The house is organized by a "public-to-private" vertical gradient. The ground level provided for animals and storage, middle floors for family living and women's quarters, and the top for high-status guests.
			The Mafraj	Located on the topmost floor, the <i>Mafraj</i> is a large, rectangular room with windows on three sides. It provides the best views and ventilation. It is used for afternoon social gatherings where men sit on floor cushions to talk and chew <i>qat</i> .
			Aesthetic	It is characterized by its "gingerbread" appearance — dark basalt stone at the base transitioning to brown brick at higher levels, decorated with white gypsum (<i>nura</i>) patterns around the windows.
2.	Multi-story house	As the city expanded westward into the Bir-Al-Azab quarter (often called the "Garden City"), the architecture changed from purely vertical to a more sprawling, garden-oriented design.	Relationship with Nature	Unlike the dense Old City, these houses were built on larger plots. The <i>Mafraj</i> was moved from the roof to the ground level to directly overlook a private garden and a reflecting fountain pool (<i>shadhirwan</i>).
			The Fountain Pool	The pool served a dual purpose: it acted as a status symbol for wealthy residents and provided evaporative cooling, making the ground-level entertaining space

				comfortable during the heat of the day.
			Suburban Feel	This type represents an early form of "suburban" development where the verticality of the tower was less necessary due to the availability of land.
3.	The Jewish House	Located primarily in the <i>Qa' al-Yahud</i> (the Jewish Quarter) in the western part of the city, these houses had to adhere to specific historical height restrictions and social customs.	Top-Level Courtyard	They were often restricted from being taller than Muslim houses, Jewish residents built "inward." The defining feature is an open-air courtyard on the upper level. This provided privacy from the street while allowing light and air to reach the centre of the home.
			Religious Function	The rooftop courtyard also served practical religious purposes, such as providing a space to build a <i>Sukkah</i> (booth) during the festival of Sukkot.

Practical necessity only partially accounts for the genesis of this architectural archetype. At its core, the drive toward the clouds was fuelled by building tradition, economic power, and competitive grandeur, with Sana'a's inhabitants continually channelling their wealth into scaling new architectural heights (Eric & Caroline, 2009)

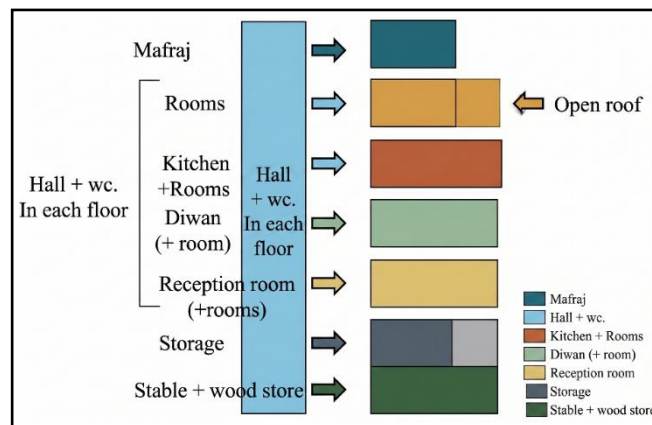


Figure 5: The Utilisation for Respectively Level in the Yemeni Traditional House

Source: Lewcock, 1986

The desirability of the traditional tower house Yemeni opening attains from five elements which are merged with all the purposes and essentials of view, lighting, ventilation, safety, and privacy. Nevertheless, these purposes would be precise by the residents liable on their community and ecological condition. The previously study, the Yemeni traditional tower houses have multiple numbers of windows. The four (4) core components of the Yemeni windows are separated within the lower part (*Taqah*), the fanlight (*Qamariyyah*), the wooden

external overhang (*Konnah*) and the small vent (*Shaquos*) show in Figure 5. Although the fanlights provide natural lighting during the daytime, the lower part section can be reduced the heat warmth and exteriors shutters can be closed without using artificial lighting.

Islam Principles on the Development of Sana'a Construction

With over three millennia of rich history, Yemen once stood as a premier economic engine of the ancient world. Its strategic location served as a crucial trade hub, bridging the commerce of India, China, Africa, and the Mediterranean (Amirdehi, 1388). The valuable and development urban resources of Sana'a, it is known as a city with the aesthetic architectural and urban stated in some published books and scientific articles. Studies show the cultural studies and its affiliation with the physical form of the city (Homafar, 2013). The introduction of Islam in the first century AD are profound alteration in Sana'a's form, shape, and architecture. All the activities are attentive by the mosque, as the other Islamic cities (Soltanzadeh *et. al*, 2015).

The city has ordinality development and is surrounded around the mosque because of security reasons (Fatemi, 1392). With the unique beliefs of Yemenis that are influenced by Islamic culture, one substantial cultural axis is recognised in addition to the fundamental elements of Islamic urban such the big mosque, market, and schools. It connected the city's most significant south gate (Yemen Gate) to its primary north gate (Shaub), and a variety of activities are carried out along this route (Soltanzadeh *et. al*, 2015). The fact that Sana'a's architectural environment has endured through multiple Islamic centuries adds to its significance as a component of global cultural heritage. Even if the ancient palaces constructed before the arrival of Islam were destroyed, their restoration has proceeded over time, and the city's original form and features have been connected to the ancient ideals. (Soltanzadeh *et. al*, 2015).

Three distinct architectural styles are associated with three distinct social classes. The eastern part of Sana'a is home to most of the city's public areas, as well as a number of mosques and markets. The palace and gardens are located in the city's centre. Yemeni architecture is developed and impacted by cultural and socioeconomic factors. Yemenis' distinctive ideas, which are influenced by Islamic culture, constitute one important cultural axis in addition to the essential elements of Islamic communities, such as the large mosque, the market, and the schools. Numerous activities take place along this path, which connects the city's most important north entrance (Shaub) to its most important south gate (Yemen gate).

Case Study: Sinan Abu Luhum House's History

The *Sinan Abu Luhum* residence is situated to the east of *Aserar Al-abhar* neighbourhood, with a huge southern side that is 19.40 metres wide and divided from the *Al-abhar* mosque by a road, and a major eastern side that overlooks the Square (sarha). On the other hand, the building's western and northern sides are connected to or adjacent to nearby structures. The edifice was constructed on 15 ADS/9H and belonged to one of the imams before being moved to *Muhsen Ma'aedh*. The building has been undergoing significant maintenance and renovations. The most recent owner of this property completed the most recent one. Before it was given to *Abu Luhum's* family, *Muhsen Ma'aedh* completed the initial renovations.

The structure has undergone numerous renovations and maintenance, which attests to the most recent one carried out by the property's owners. It was initially owned by Muhammad Ma'adh before being transferred to the Abu Luhum family in 1962–1382.

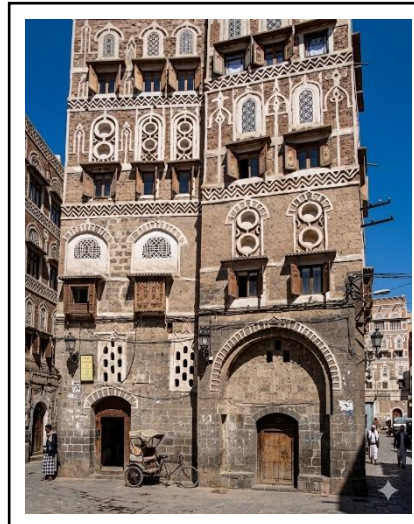


Figure 6: Façade of Sinan Abu Luhum

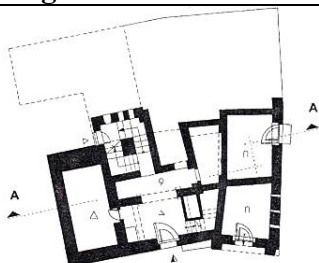
Source: Author, 2023

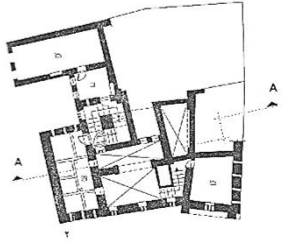
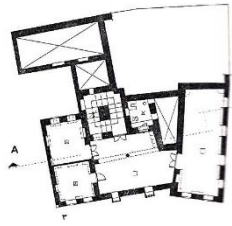
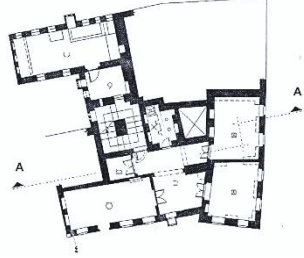
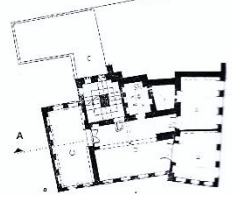
With six stories, including the mezzanine, the structure is categorised as a large residential building. Because of its ornate values and historical architecture, it is one of Sana'a's most significant residential structures.

The Layout Plan for the Tower House

The *Abu Luhum* Tower House is a six-story structure located in Yemen's ancient city of Sana'a. Within the UNESCO World Heritage site of the ancient city of Sana'a, the *Abu Luhum* home is among the most notable specimens of traditional Yemeni "tower house" architecture. It is a vertical microcosm of Yemeni social and functional hierarchy, at six stories tall.

Table 3: The Tower House Activities

Level	Drawing	Measurement (unit: meter)		
Ground Floor		Level / Space	L	W
		A	5.50m	4.50m
		B	4.70m	1.80m
		C	4.50m	4.30m
		D	5m	4.30m
		E		-
		F	8m	3m

First Floor		<table> <tr> <th>Level/Space</th><th>L</th><th>W</th></tr> <tr> <td>A</td><td>8m</td><td>3m</td></tr> <tr> <td>B</td><td>4.50m</td><td>4.30m</td></tr> <tr> <td>C</td><td>-</td><td>-</td></tr> </table>	Level/Space	L	W	A	8m	3m	B	4.50m	4.30m	C	-	-									
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Second Floor		<table> <tr> <th>Level / Space</th><th>L</th><th>W</th></tr> <tr> <td>A</td><td>9.5m</td><td>6.5m</td></tr> <tr> <td>B</td><td>6.5m</td><td>7m</td></tr> <tr> <td>C</td><td>3.50m</td><td>3.30m</td></tr> <tr> <td>D</td><td>3.50m</td><td>3.30m</td></tr> <tr> <td>E</td><td>-</td><td>-</td></tr> <tr> <td>F</td><td>-</td><td>-</td></tr> </table>	Level / Space	L	W	A	9.5m	6.5m	B	6.5m	7m	C	3.50m	3.30m	D	3.50m	3.30m	E	-	-	F	-	-
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E	-	-																					
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Third Floor		<table> <tr> <th>Level / Space</th><th>L</th><th>W</th></tr> <tr> <td>A</td><td>9.20m</td><td>3.40m</td></tr> <tr> <td>B</td><td>3m</td><td>3.60m</td></tr> <tr> <td>C</td><td>3m</td><td>7m</td></tr> <tr> <td>D</td><td>7.50m</td><td>1.80m</td></tr> <tr> <td>E</td><td>3m</td><td>2.40m</td></tr> <tr> <td>F</td><td>4m</td><td>3m</td></tr> </table>	Level / Space	L	W	A	9.20m	3.40m	B	3m	3.60m	C	3m	7m	D	7.50m	1.80m	E	3m	2.40m	F	4m	3m
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Fourth Floor		<table> <tr> <th>Level / Space</th><th>L</th><th>W</th></tr> <tr> <td>A</td><td>9.60m</td><td>3.40m</td></tr> <tr> <td>B</td><td>5.50m</td><td>3.60m</td></tr> <tr> <td>C</td><td>7.90m</td><td>3.20m</td></tr> <tr> <td>D</td><td>6.40m</td><td>1.80m</td></tr> <tr> <td>E</td><td>4m</td><td>3m</td></tr> </table>	Level / Space	L	W	A	9.60m	3.40m	B	5.50m	3.60m	C	7.90m	3.20m	D	6.40m	1.80m	E	4m	3m			
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Conclusion

This study identifies the Yemeni people's activities that affected the traditional tower homes' layout plan in Sana'a's ancient city, as well as how those activities related to the layout plan and spatial organisation. The report also concludes that the Yemeni inhabitants' social, cultural, and religious activities are justified. The tower house spaces also changed the functions of the level of the tower houses according to the need of the space. As for example, the Al- Kurs room where the (animals stable) was located, most of the tower houses has changed the previous function to storage. Likewise, the same spaces also can be changed to a complete apartment whenever it suits their needs, especially when there is more than one family. Its success lies in its ability to maintain a traditional exterior and "soul" while the interior remains fluid enough to adjust to the shifting economic realities and social structures of its inhabitants. It proves that ancient high-density designs can remain functional in a modern context through internal adaptation.

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- Ethics Statement:** This study was conducted in accordance with ethical research standards. Informed consent was obtained from all participants prior to data collection. Participation was voluntary, and respondents were assured of confidentiality and anonymity. The data collected were used solely for academic purposes.
- Author Contribution Statement:** All authors contributed significantly to the development of this manuscript. Abu Bakar Abd Hamid was responsible for the conceptualization, methodology, and overall supervision of the study. Mohd Azrol Baharudin handled data collection, analysis, and interpretation of results. Norashikin Rahmat and Rasha Shaia'a Naji Sada'an contributed to the literature review, drafting, and critical revision of the manuscript. All authors read and approved the final version of the manuscript prior to submission.
- Declaration on the Use of Artificial Intelligence (AI)** "The author(s) declare that generative AI or AI-assisted technologies were used during the preparation of this manuscript. The following tool(s) were used: Gemini and Quillbolt. The tool(s) were used for language editing, grammar improvement, translation, and paraphrase. All AI-assisted content was reviewed and verified by the author(s), who take full responsibility for the accuracy, originality, integrity, and final content of the manuscript."
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References

- Abdussamad, S. (2021). Islamic perspectives: An Alternative to the existing model of social sustainability in architecture. *Astrolabe: A CIS Student in Research Engineering Journal*. <https://www.hbku.edu.qa/sites/default/files/islamicperspectivearchitecture.pdf>.
- Ahmed, S. A. (2020). Traditional multi-story house (Tower House) in Sana'a City, Yemen. An example of sustainable Architecture. *Alexandria Engineering Journal* (2020) 59, pp. 381–387.
- Al-Taher Engineering Consulting Centre. (2005). The foundations of architectural design and urban planning in the various Islamic eras - an analytical study on the capital, Sana'a. Book. Organization of Islamic Capitals and Cities.
- Al-Thahab, A., & Mushtaha, E. (2018). Spatial organization and socio-cultural values in traditional Yemeni tower houses: The case of Old Sana'a. *Journal of Asian Architecture and Building Engineering*, 17(2), 245–252.
- Al Sayyed, W. (2012). The Morphology of The Traditional Arab House, Examining courtyard and non-courtyard prototypes. *Art & Architecture Magazine – London*, Issue 10, pp. 9-27
- Amirdehi, A. R. (1388). Land of the Islamic world: Yemen, ancient civilization from Sana'a to Aden's. *The Idea of Approximation Journal*, 21, 115–126.
- Eric F. and Caroline S. (2009). *The Urban Housing Handbook*. John Wiley and Sons. ISBN 978-0-470-51275-3, www, muslim heritage, Com, by Saoud, 2017
- Fatemi, N. (1392). Historic cities in the Muslim lands in the evolution of the physical exploration of Islamic Cairo, Proceedings of doctoral students of Islamic Azad University of Qazvin city. Chahar Tagh Ed.
- Gelbart, J. J. (2021). Old City of Sana'a (Yemen), World Heritage Convention (UNESCO). Edition Gelbart.
- Homafar, M. (1932). Recognize the role of cultural variables, social and economic construction and evolution of the city (Case Study: City of Dameshgh). In Proceedings of the PhD research Urban. Tehran.
- Lewcock, R. (1986), *The Old Walled City of Sana'a*. Paris: UNESCO.
- Muhammad Ali A. (2007). Samira Al-Shawash: The effect of Climatic Conditions on the Architectural Character of Yemeni Cities: A Study of their Application to Cities - (Zabid, Sana'a, Shibam, Hadhramaut). Third Housing Symposium, the High Authority for the Development of Riyadh. Kingdom of Saudi Arabia. 2007.p 65-66.
- Soltanzadeh, H., & Moghaddam, M. S. (2015). Sana'a, Structure, Historical Form, Architecture and Culture. In *Civil Engineering and Architecture* (Vol. 3, Issue 3, pp. 56–67). Horizon Research Publishing Co., Ltd. <https://doi.org/10.13189/cea.2015.030303>.
- Tihama huts, <https://www.google.com/search?sxsrf=ACYBGnQwG5H-LFILIJv6adM8ngp02VKiQ:1577335118700&q=hut+architecture+in+yemen&tbm=Oldest&skyscraper,Shibam,Yemen,https://www.google.com/search?q=9hibam+Yemen&sxsrf=ACYBGNT0bzxhoDczRkaq2uBpg5>.
- Veranda, F. (1982). *Art of Buildings in Yemen*. Massachusetts Institute of Technology. Cambridge, Massachusetts. The MIT Press