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Functional Solution of Bukhara Traditional Houses

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Abstract: This study explores the functional solutions embedded in traditional houses of Bukhara, Uzbekistan, highlighting how local architectural practices respond to environmental, social, and cultural demands. Traditional Bukhara houses, characterized by inward-oriented layouts, courtyards, and thick adobe walls, offer sustainable solutions suited to arid climates. Despite their historical and cultural significance, modern urban development often overlooks these vernacular strategies, leading to a disconnect between contemporary housing and local climatic needs. The knowledge gap lies in the insufficient integration of these traditional practices into present-day architectural planning. Using a qualitative methodological approach, including field surveys, spatial analysis, and comparative architectural review, this research examines the design logic, spatial organization, and climate adaptability of selected heritage houses in Bukhara. The findings reveal a sophisticated interplay between passive cooling techniques, privacy-driven spatial planning, and multifunctional spaces that support both individual and community life. The results underscore the efficiency of traditional solutions such as the central courtyard's role in ventilation and thermal regulation, as well as the seasonal use of rooms based on solar orientation. These insights suggest valuable strategies for sustainable architecture in similar climatic zones. The study implies that incorporating traditional knowledge into modern design not only preserves cultural identity but also promotes environmental resilience and functional efficiency in contemporary housing models.

Keywords: cotton houses, patio, one-room houses, interior courtyard houses, wooden columns, functional solutions.

Introduction

The Bukhara region, located in the western part of Uzbekistan, is windy because it consists of vast plains and plains, hot in summer and dry and cold in winter. On the cold days of summer, the air stung the nose of a person breathing in the region because of the hot and dry climate. Of course, this region has been a major economic and political center throughout history and served as the center of the Bukhara Emirate during the khanates. When the works of architects and builders of that time were studied by scholars and representatives of the field, they mainly designed rectangular houses with high porches for this climate, and the porch on the west side was designed to be higher than the porches on the other side. The main reason for this was to direct the wind flow to the courtyard. Mulberry trees were mainly planted in the centers of houses, mosques, palaces and even addressees in the region. One of the main reasons for this is that the mulberry tree is resistant and is an adaptable plant to a dry, hot climate without water[1].

Bukhara, one of the oldest cities in Central Asia, is renowned for its rich cultural heritage and distinctive architectural identity. For centuries, traditional houses in Bukhara have exemplified the harmony between architecture and environment, reflecting not only aesthetic values but also practical solutions to extreme climatic conditions. These houses, built with natural materials and

designed with intuitive spatial strategies, have sustained generations, offering insight into how vernacular architecture can address both environmental and socio-cultural needs[2].

Traditional Bukhara houses are distinguished by features such as thick adobe walls, central courtyards, seasonal rooms, and elevated platforms. These elements are not arbitrary but reflect deliberate design choices aligned with local climate and Islamic social norms, especially privacy and family-centered living. Theories of vernacular architecture and passive design such as Oliver's and Rapoport's works underscore the significance of context-based design solutions. However, in modern urban development, such traditional knowledge is often disregarded in favor of generic, Western-style housing that fails to respond adequately to local needs[3].

Despite the growing recognition of sustainable architecture, a critical knowledge gap remains in understanding and applying the functional wisdom of Bukhara's traditional houses in contemporary contexts. While some studies have documented architectural forms and historical significance, few have thoroughly analyzed their performance-based functionality, particularly in thermal regulation, spatial adaptability, and social coherence. This study aims to bridge that gap through a functional evaluation of selected traditional houses using architectural analysis, thermal observation, and comparative study[4].

A qualitative methodology is adopted, combining field surveys, spatial mapping, and interviews with local residents. The study also includes thermal comfort analysis using passive design evaluation tools to assess the effectiveness of traditional features in regulating temperature and improving habitability. These methods aim to not only describe but critically assess how traditional solutions meet functional demands over time[5].

Methodology

This study employed a qualitative research methodology aimed at uncovering the functional aspects of traditional houses in Bukhara through a combination of fieldwork, architectural analysis, and comparative evaluation. Data collection began with site visits to selected heritage houses within the old city of Bukhara, chosen for their preservation of original structural elements and spatial composition. Direct observation was conducted to document architectural features such as wall thickness, courtyard dimensions, room orientation, and ventilation strategies. These observations were supplemented with photographic records, sketches, and spatial measurements to accurately capture the physical characteristics of the houses. Semi-structured interviews with local residents, craftsmen, and heritage experts provided contextual insights into the functional use of space and traditional construction techniques. In parallel, archival research and literature review were conducted to understand the historical development of Bukhara's residential architecture and its relation to social and climatic factors. The study further applied passive design principles to evaluate the thermal behavior of key architectural features such as courtyards, iwans, and seasonal room arrangements. Findings were analyzed through comparative assessment with modern building performance standards to highlight the efficiency of traditional solutions. This multi-method approach enabled a holistic understanding of how these houses function not only as living spaces but also as adaptive systems finely tuned to the environmental and cultural context of Bukhara. The methodology aimed to bridge traditional architectural wisdom with modern evaluation techniques, providing a foundation for integrating vernacular strategies into contemporary sustainable housing design[6].

Result and Discussion

Bukhara region served as the center of Islamic religion, a center of knowledge and enlightenment. Due to the strong development of Islam, traditional dwellings in the region were mainly formed along thin and narrow streets without windows on the outside. Small ditches on the streets, i.e. they were provided with such memory solutions to prevent the accumulation of sewage system water (rain and snow). The foundation of most of the dwellings was mainly built of mud walls and mud bricks. Stones were used in the region for the foundation. On the foundation, mulberry and plane trees cut with the help of holes made by local craftsmen are laid, and the timber (sinch) is fixed on it in a structural system[7].

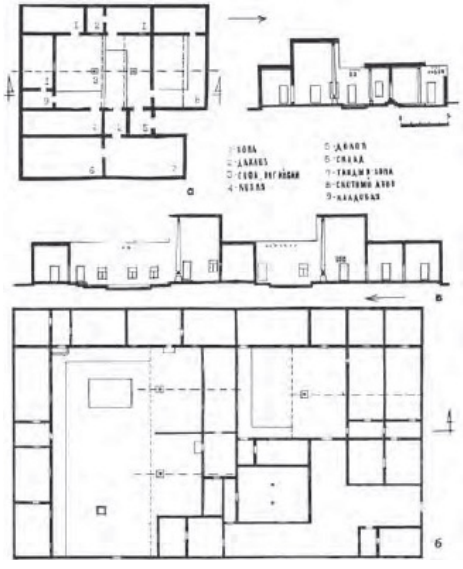
After the timber is fastened together like a truss, a roof is built around it and it is filled with a mixture of clay prepared from a mixture of local yellow soil and straw and straw for several days. This clay is poured 30.40 cm thick, and only after a day or two of the clay has dried, the next layer is poured. In this way, the clay is dried and turned until it reaches a uniform height. The term "sinch uyim tınch uyim" is used among the people. From this term, we can understand that the sinch type of construction is considered very strong and durable. The entrance to the courtyard is mainly through a small door with a height of 180 cm. The main reason for this is so that the dust from outside does not enter the courtyard and, in accordance with Islamic traditions, to show respect and greet the person inside, the doors are made this high. (Figure 1)

Figure 1. One-yard houses

This type of courtyard is usually a small gatehouse after entering the entrance gate and you will not see any open doors or windows after entering. After the turns, you will enter a large open central courtyard. Around this courtyard, houses were built in a rectangular shape. In the center of the courtyard, a pond was built. The main function of the pond was to provide water for the household to use even in times of drought. This in turn was able to maintain the air temperature in the place at a certain percentage[8].

Two-courtyard houses. Rich nobles, large landowners and wealthy people of their time built and lived in two-courtyard houses. Due to the hot weather and to avoid being noticed by guests who came to visit the women, an inner courtyard was built for women. The outer courtyard was mainly used for household chores, while the inner courtyard was used for women and girls, and they were engaged in labor activities. (Figure 2)

Figure 2. Two-courtyard houses



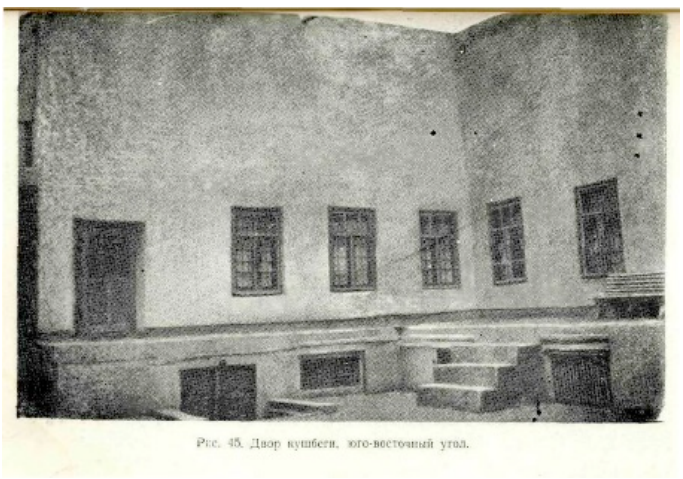
The narrow appearance of the houses is mainly from one porch to the other, the main reason for this is that the hot and cold air stays in the house and does not enter the room. In the center of the room, the family room is a deep concreted area. Here, on winter days, family members sat under a blanket around a fire. There was no need for any other clothing. The entrance to the room was built of baked brick walls[9].

The room was made of one-layer clay, and shelves of the same thickness were placed on the inside. Concrete and stones were used extensively in the 19th-20th centuries with the help of wide columns and crafts. The most ancient and main manifestation, which is currently attracting world attention, is the Arki Khan Palace in Bukhara, which had several rooms, open summer cottages and wooden platforms inside. At the same time, the document clearly shows the traditional image of a house being built by the people, which is still used today as a symbol for those living in it. (Figure 3)

Figure 3. Andreev M, Chekhovich O D Ark Bukhara

When houses are built on the street side, there are mainly windows only on the 1st floor. The main reason for this is that during hot and cold periods, neither cold nor hot air enters from above. Therefore, the windows of houses with inner courtyards are small and on the 1st floor. Fresh air enters freely from inside and that air exits through the walls. Several holes are left between the walls during the construction process. The same is true on the street side. Due to the narrow streets, the cold air does not enter the room. That is why windows were not placed on the second floor. (Figure 4)

Figure 4. Houses 1st floor



However, the porches of the inner courtyards are high, up to 2 floors or even higher, and the cool breeze coming from this porch is distributed to the inner courtyard and the inner courtyard to the rooms through the windows. This is still the traditional way of building houses today[10].

That's why the mansions are built much higher than the surrounding buildings. On hot summer days, if you can go up to rest and eat, the cool breeze from above will not be blocked by other trees or local courtyards. (Figure 5)

Figure 5. 2nd floor of houses

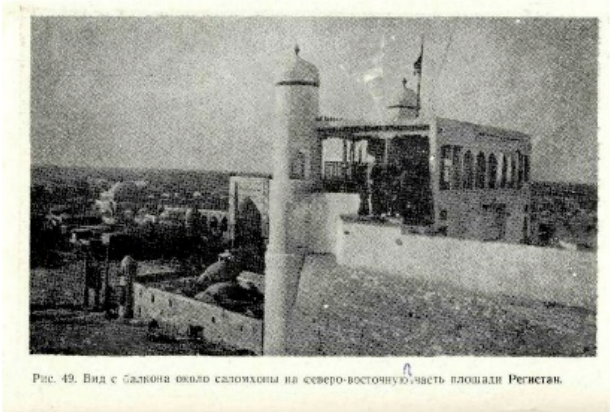


Рис. 49. Вид с балкона около саломхоны на северо-восточную часть площади Регистан.

By the 17th century, Bukhara had largely taken shape as a historical city. In the 16th century, the southwestern part of the city, which belonged to the sheikhs of Juybor, was also surrounded by a fortified wall and incorporated into the city. This gave the city its final, most expanded appearance. There were eleven gates in the city. One of them, the Sheikh Jalal Gate, is relatively well preserved. Its previous system left its mark on the history of the city. The historical appearance of Bukhara is largely determined by a number of complexes inside and outside the city[11].

The center of Bukhara has the appearance of a single, huge complex. It mainly occupied the western and southern streets of the early medieval shahristan. The center began from the Poyi Kalon complex in the west. Toqi Zargaron Chorsusi represents the center of the shahristan. To the east of it, on both sides of the street, are the Ulugbek and Abdulazizkhan madrasas. To the south of Zargarlar Chorsusi is the Abdullakhan Timi. At the beginning of the 20th century, caravanserais and shops were densely packed together in these places. They have not survived to this day. The shahristan is strengthened by the early medieval gate, and later by the Toqi Telpakfurushon, the knot of radiant streets that formed in place of the gate[12].

While Zargarlar Chorsusi solved the problem of urban planning strengthening the intersection, a much more complex problem was solved in Telpakfurushlar Chorsusi, where a building was erected that divided six streets. To the north of the Telpakfurushlar hill is the Sarrofan bathhouse. Its history reflects a complex urban development situation[13].

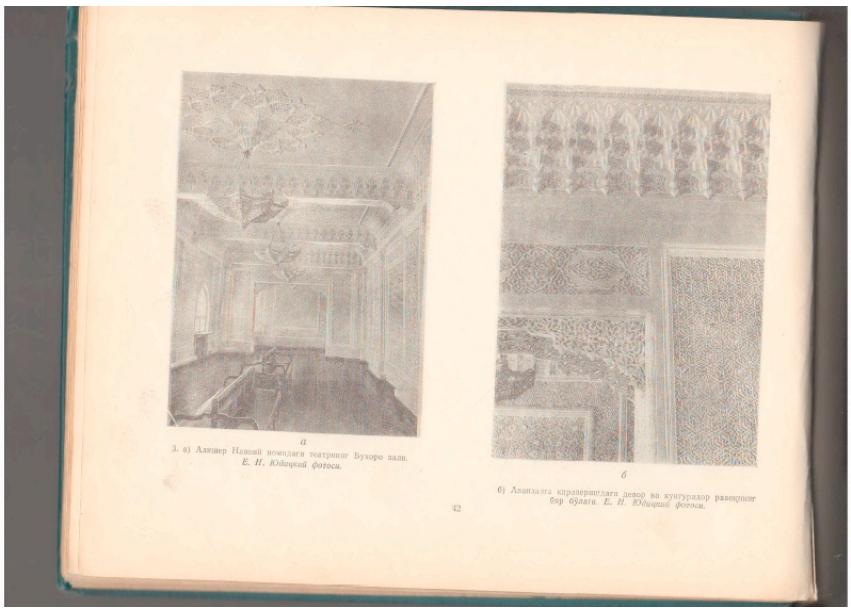
In addition to the complexes in the center of Bukhara, the Labi Pool and Qosh Madrasah complexes were also formed in the city in the Middle Ages.

In the Labi Pool complex, around the octagonal pool, there is the Kukaldash Madrasah and a khanaqoh and a madrasah in the qosh system[14].

If we look at those, they played a role in the interior decoration of Bukhara, mainly reflecting the nationality and decorating their homes, such as decorating theroomand harmonizing the national identity[15].

The decorations and ornaments of the houses were mainly made by folk craftsmen, painters, sculptors, and artists, and even gold was used in the residences of the palaces. A clear example of this is the Summer Palace of Sitorai Mohi Hosa. (Figure 6)

Figure 6. Sitorai Mohihosa Palace Summer Palace



Conclusion

The study of Bukhara's traditional houses reveals that their architectural design is deeply rooted in functional responses to the region's harsh climatic conditions and cultural values, particularly through the use of courtyards, thick adobe walls, and seasonally adaptable living spaces. These elements collectively contribute to thermal comfort, privacy, and spatial flexibility, demonstrating a sophisticated understanding of passive environmental control long before the advent of modern technologies. The findings emphasize the relevance of integrating such vernacular principles into contemporary architectural practices, especially in arid and semi-arid regions where sustainable housing solutions are urgently needed. The implications suggest that modern architecture can greatly benefit from the adaptive strategies embedded in traditional design, not only to enhance environmental performance but also to preserve cultural continuity. Further research is recommended to explore how these traditional concepts can be systematically incorporated into urban planning policies, building codes, and modern construction techniques, potentially through experimental housing models and interdisciplinary collaboration between architects, historians, and environmental engineers.

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