



PRESERVING AND SUSTAINING THE ENVIRONMENTAL IDENTITY OF ISLAMIC RESIDENTIAL BUILDINGS IN THE HEJAZ REGION IN KSA

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ABSTRACT

The Kingdom of Saudi Arabia has a rich urban and architectural legacy that dates back to the numerous eras of Islamic civilization. This study investigates the environmental influence on Ottoman-style heritage structures in the Kingdom of Saudi Arabia, particularly in the Hejaz Region. The region was chosen because of its diverse climates, which include a hot, dry environment in the middle of the Western Desert and a hot, humid climate on the Red Sea coast. Heritage buildings are examined from design, architectural, and urban perspectives to learn how environmental sustainability is achieved and to examine building materials and their sustainability. Furthermore, common architectural characteristics, systems, and designs are recognized to be integrated into modern building design for the contemporary era to maintain their design uniqueness.

KEYWORDS:

Islamic architecture; Islamic residential Buildings; Social Environment; Climatic Environment; Sustainability; Sustainable Building Materials.

INTRODUCTION

The Islamic traditional urban fabric is quite similar across Saudi Arabia because of similar cultural and social environments and the same Islamic values and teachings influencing the population structure. The climatic and natural environments in Saudi Arabia affecting the design of residential buildings are also quite similar. Many types of heritage dwellings have various designs due to the vast breadth of the Kingdom's lands. The Ottoman period influenced the architectural design of residential buildings as it was the last Islamic Caliphate. The residential architecture of that era was rich in architectural vocabulary, which was heavily influenced by the religious and social environments and the climate environment.

The research study aims to analyze the building environment of heritage houses in the Kingdom of Saudi Arabia, especially in the Hejaz region. This choice is due to the expansion of the Hejaz area and its presence in the Western Desert extending to the Red Sea coast. Additionally, the region was chosen because of its varying climate, divided into the hot, dry climate of the cities in the heart of the Western Desert and the hot, humid climate of the cities on the Red Sea coast. Heritage buildings are analyzed in terms of architectural and urban design and the extent to which they achieve environmental sustainability through their building materials. In addition, identifying the characteristics of architectural design and systems of that historical era can be useful in designing contemporary buildings to keep pace with modern times while maintaining cultural identity. These

categories describe how the research project is divided: Theoretically, the study first examines the urban and architectural legacy of the Hejaz region (Western Region) during the Ottoman Caliphate period. It also analyzes the location's geography and climate, traditional residential buildings' history, form, design, and the overall urban fabric. Also included is an explanation of the environmental and social principles used to examine residential structures. Second, to compare the architectural and urban forms and to examine the degree of sustainability achieved during the Ottoman era of heritage residential buildings in the Hejaz region. Third, to define the traits and terminology of architectural and environmental structures and how they can adapt to the modern era.

METHODS

The methodology of the research study is divided into the following: First, the theoretical study deals with the urban and architectural heritage of the Hejaz region (Western Region) during the Ottoman Caliphate period, as well as the analysis of the location's geography and climate, as well as the history, form, design, and urban fabric of the traditional residential buildings. Moreover, the theoretical study covers the definition of the environmental and social principles by which residential buildings are analyzed. Second, to perform an analytical study of heritage residential buildings in the Hejaz region in terms of architectural and urban form and the extent to which sustainability was achieved during the Ottoman era. Third, to identify the characteristics and vocabulary of

architectural and environmental buildings and how they can adapt to the modern era.

RESULT

IDENTIFYING THE ARCHITECTURAL AND URBAN ISLAMIC HERITAGE OF HEJAZ (WESTERN REGION OF SAUDI ARABIA) DURING OTTOMAN CALIPHATE

The architectural and urban building heritage are addressed from the historical point of view, the general location, and the climate of the area. These are divided into:

1. Geography of the region

The Hejaz area in the west of the Kingdom extends from the Ras Al Malik region in the far north to the ponds in the south, bordered to the east by Riyadh and Al Qassim and by the Red Sea coast to the west [1]. It includes Mecca, Madinah, and Al-Taif, located in the heart of the desert, while the other cities are on the Red Sea coast. The most important coastal cities are Jeddah, Yanbu, and other cities and villages (Fig.1).



Figure 1. West Zone (Hejaz zone) [1]

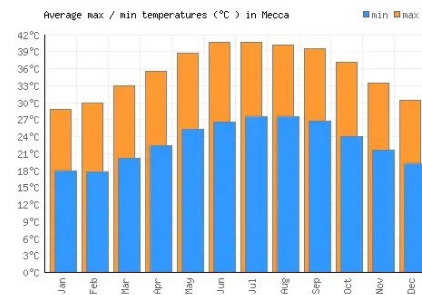
2. Climate of the Region

The climate in the western region of the Kingdom is divided into: (Fig.2)

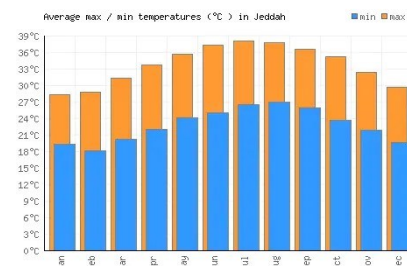
- Warm, dry climates: Temperatures vary from 27.5 to 30 degrees in the winter and can reach 45 degrees in the summer, and the cities that belong to this climate are Mecca, Medina, and Taif [2].
- Hot and wet climate: Temperatures vary between 21 to 29 degrees in the winter and can reach 39 degrees in the summer, and the cities that belong to this climate are Jeddah and Yanbu because of their existence along the Red Sea coast. The rain generally falls in the Hejaz region (western region) in the spring, with the maximum precipitation in April and November in autumn.

3. Urban and Architectural History in Hejaz Region

The cities of the western region are located on paths traversed by pilgrims and used as trade routes [4] (Fig. 1). Multistorey residential buildings typically have four floors with vaulted ceiling entrances topped by circular arches and doors of carved wood. The wooden carvings Rawashin cover the external facades (Fig. 3) [4], and the use of the building materials in the region is similar, which is all known as the Hejaz architectural style. Two factors have had the most significant impact in determining the shape of buildings in the region: Tradition and Climate.



(a) Mecca weather averages and monthly temperatures



(b) Jeddah weather averages and monthly temperatures
Figure 2. Climate chart for Hejaz zone

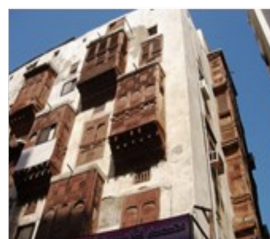




Figure 3. Heritage buildings in the Hijaz area [1]

THE CONCEPT OF SUSTAINABLE ISLAMIC URBAN AND ARCHITECTURAL AREAS

This section will address the sustainable design foundations of urban areas and architectural buildings in different climates and environments:

1. Sustainable Urban Design Principles

According to Salih [5], the planning foundations for a sustainable city are:

- Adapting the urban structure to the local environment, such as geographical location and climatic factors, reduces energy consumption to achieve human thermal comfort and uses natural elements such as water and trees to improve various climatic conditions.
- Respect the humanitarian standard in the travel distances and distribution of essential services such that the population can access them on foot and give priority to pedestrians followed by transport.
- Enhance the aesthetic value of urban areas.

2. Principles of Sustainable Architectural Design

The most important principles of sustainable green architecture are conserving natural resources, reducing the buildings' energy consumption to as little as possible, and reducing pollutants emitted from the building. To achieve these principles, green architecture uses several architectural solutions, the most important of these are the following [5]:

- The use of natural environment-friendly building materials, which are recyclable, are not harmful to health and do not emit harmful gases to humans or the environment.
- Use design solutions to overcome climatic conditions, such as providing good lighting and ventilation, naturally achieving human comfort, taking advantage of the benefits trees and plants provide in shading and improving the local environment, eliminating carbon dioxide and producing oxygen.
- Employing modern technology to use the least energy in cooling, heating, lighting, and other uses.

A COMPARATIVE ANALYTICAL STUDY OF THE ENVIRONMENTAL IMPACT ON THE DESIGN OF ISLAMIC RESIDENTIAL AND URBAN AREAS IN THE HEJAZ REGION (WESTERN REGION)

Assessing the criteria and principles for sustainable design of urban areas and residential buildings in this region was achieved by analyzing each of the following elements:

1. Achieving sustainability in the urban fabric design in the Hijaz region with its different cities

The urban fabric of the western region is generally characterized by the density and proximity of architectural blocks intermingled with winding roads, with their functions determining their breadth or narrowness. This is called compact urban composition, which leads to squares of mosques and markets and achieves sustainability in the urban fabric design of the different cities in the region of Hijaz.

Madinah used a different system to the lanes system common in most Islamic cities. It uses a system of courts that characterizes its urban texture. The lanes branch from the main street through a gate leading to a space called the court, which is surrounded by a group ranging between 20 to 40 houses with one or two entrances shaded from above. These courts fulfill the humanitarian needs of social communication (Fig. 4 and Fig. 5) [6].

The compactness of buildings characterizes the coastal cities such as Jeddah and Yanbu, but where the temperature is high, the urban fabric has taken the strip shape on the coast to benefit from the sea breeze and creating "arteries" in the form of winding corridors helped the cohesion of the houses and formed good airways due to being open to the sea. Here appears the compatibility with the geographic environment of the site (Fig. 6) [7].



Figure 4. The prevailing system of fountains in Madinah, the dry hot zone [1].

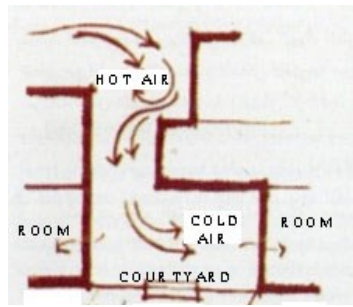


Figure 5. Air traffic in the monsters in Madinah



Figure 6. Compact Urban Fabric in the Western Region

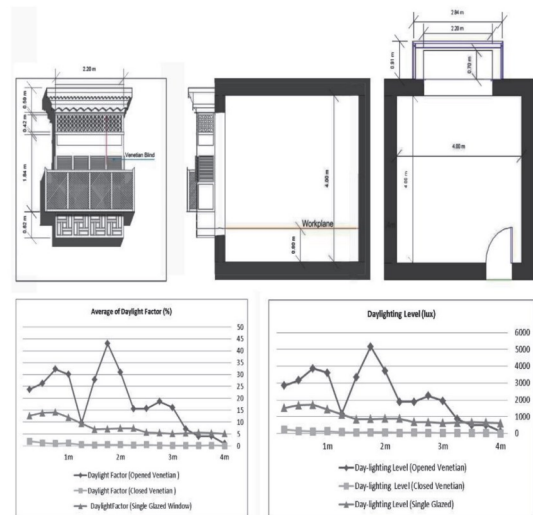
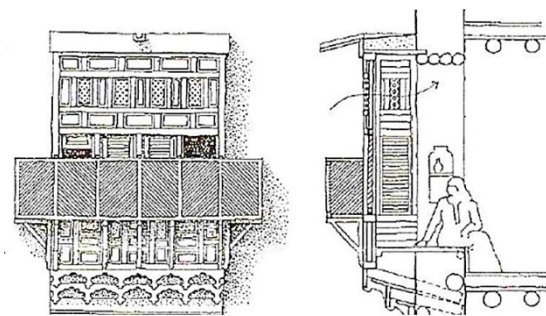


Figure 7: Daylight factor and daylight level of examined single glaze, closed Venetians, and Rawashin (Mashrabiya) [8], [12].



2. Achieving sustainability in the architectural design of residential buildings in the Hijaz region

A. Design of Traditional Buildings for Local Environmental Compliance and Sustainability

In early Islamic times, the architectural design of the traditional residential buildings was to overcome the difficult climatic conditions, and the buildings corresponded with the social and economic aspects of that time.

a. Design solutions to overcome climatic conditions

- The use of Rawashin (Mashrabiya) (Fig. 7) is abundant in all the cities of the Hijaz, which are protruding wall panels covered by narrow wooden cartels that increase the shadows of facades and thus reduce the exposure of the walls to the sun. The Mashrabiya function is to cool air temperature and provide proper ventilation, allowing for natural lighting while minimizing glare (Fig. 7) [8]. The Mashrabiya is composed of a group of small wooden carvings that widen from the bottom to the top [9].



Figure 8. Use of a stairwell to distribute air inside the building rooms. MADY M., 2018, pp. 17

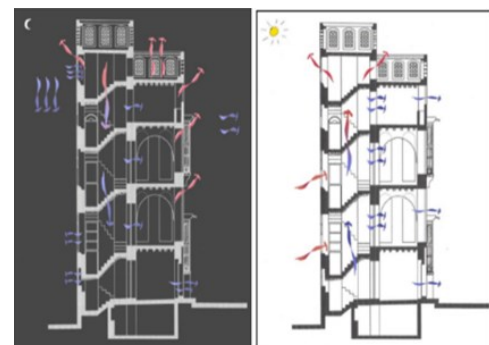


Figure 9. Use of the staircase to circulate air at night.

- Positioning the staircase in the middle or back of the building worked as a chimney that carried the hot air out of the residence (stack effect). The mouth of the airshaft was typically built open to the sky and did not comprise openable flaps to control the airflow in the shaft [11]. It is considered a traditional method of ventilation in the Hejaz area to provide comfort to the inhabitants of the building through evaporative cooling by utilizing high-rise houses' properties to pull the air currents with many openings in the walls. The absence of an internal courtyard characterized the buildings, and the distribution of rooms around the stairwell was the outlet for vertical ventilation (Fig. 8, 9, 10) [1].

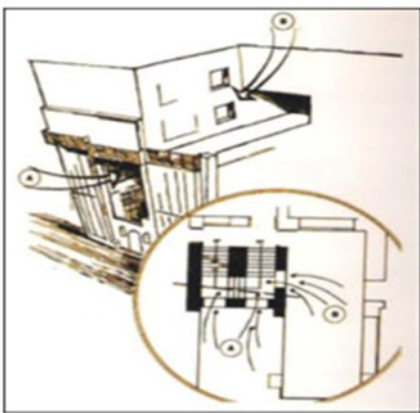


Figure 10. Use of the stairwell to distribute the air during the day.

- The use of thick walls in adjacent residential buildings maintains the thermal edge to them, which provides shadows from the blocks of neighboring buildings, and screws (openings in the walls of roofs) to renew the air and use them to sleep in the summer at night.

b. The Architectural design of the Hejazi housing to comply with social and economic values

When designing residential buildings, men and women were separated to conform the design of the dwelling to the religious and social aspects of the time. The separation is either horizontal or vertical; the women have their halls, and the others for men are on the ground floor; in other words, the house is designed for the ground floor to be only for men, visitors and services, and for the upper floors to be only for women and the people of the dwelling.

The general distribution of the traditional residence in the Hejaz is derived from the distribution of the various models of houses built in the Arab world. There is an open courtyard surrounded by rooms, mainly in Madinah and the outer courtyard of Mecca (Fig. 11) (Fig. 12). Most residential buildings use the vertical direction to provide land supply suitable for construction with economic conditions [6].

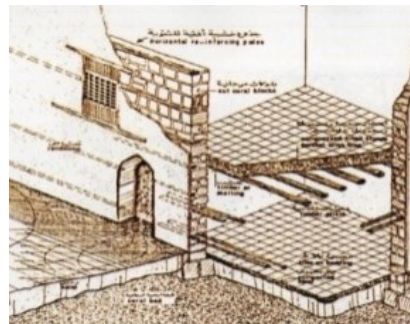


Figure 11. Residential buildings in the dry hot area, such as Madinah houses, contain an internal courtyard [12]

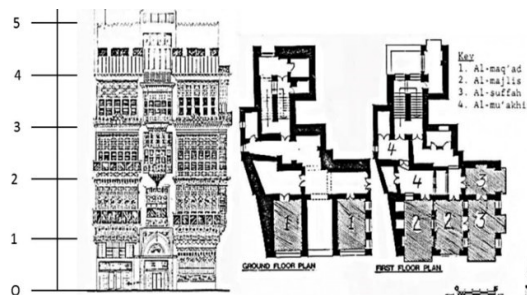
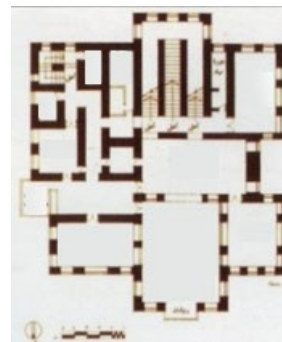


Figure 12. Residential buildings in the humid, wet area were designed without a courtyard. For example, the city of Jeddah [13]

B. Local building methods using local materials with good, sustainable environmental impact

Sustainability research has shown the importance of using local, sustainable building materials. The buildings of the Hejaz region and the Arab-Islamic countries have been characterized by their dependence on local environmental materials. The following is a review of building materials in traditional buildings (Fig.13 and Fig. 14) [14]:

- Stone: Coral limestone was used in coastal cities such as Jeddah and Yanbu. Solid mountain stone was used in all mountainous cities such as Mecca and Taif (Fig. 14). As for houses in Madinah, it was built of carved basalt stone available in lanes, and bricks were made from nearby silt available in the valleys.
- Brick: Light brick blocks were painted blue and red and nicely crafted. The mix of brick, which was made from clay and animal dung, was fermented in holes and then poured into wooden molds that were left to dry and

become solid.

- Timber: Several types of local wood available in the area were used in the construction, such as date palm tree wood, palm tree wood, acacia, beech, and pine found in Najd and Hejaz.
- Mortar: The silt was used as a sedimentary material in the mortar and it is available in Jeddah in flooded areas. It can paste two blocks of solid sea stone together, similar to cement. Construction in Mecca used a fill of date palm mixed with black silt to obtain a stable and thick mortar called molasses.

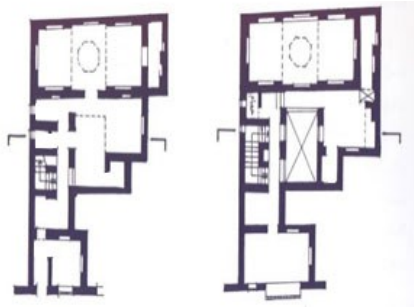


Figure 13. illustrates how to construct an external wall [14]

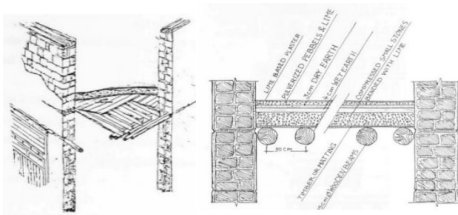


Figure 14. A partially detailed section showing the construction system and a Typical section showing roof and ceiling construction [15]

DISCUSSION

We shall demonstrate ways to improve the future of Urban and architectural areas and the formation of sustainable Islamic cities. Based on the analysis of the previous heritage buildings' architectural design and the environmental materials used in the construction of the residential buildings, we conclude that successful urban and architectural design of residential buildings in Arab Islamic countries can be achieved in the future as follows:

1. The foundations of the formation of sustainable urban areas through:

- Urban configuration of human measurement
- The small size of urban communities provides the possibility for pedestrian movement. However, it restricts the movement of vehicles to achieve the diversity of options and services within the network model of groups of independent urban communities such as neighborhoods and small urban housing groups.
- The compact fabric in Islamic cities integrates the urbanization structure to meet the needs

and provide services to most of the population.

- The formation of a self-balanced city with an attempt to prevent and reduce the problems of consumption of resources and energy. In addition to achieving environmental balance and social and economic justice.

2. Means of energy conservation in future residential buildings

A. Principles of sustainable environmental and architectural design

- Designing the building based on the environmental conditions, topography, surrounding climate, and solar energy variables at the construction site to increase its thermal efficiency. This is done by studying the characteristics of the building site, its relation to solar energy variables, and its shape determination (horizontal projection, building height, no. of stories), building orientation, choosing the appropriate shape of the building, and selecting the size of the openings of the doors and windows and its location in the facades of the building to facilitate control of the amounts of solar heat entering it in summer and winter, and reduce the thermal loads of the building.
- Increase the functional efficiency of the existing elements of the environment (lighting and ventilation) and increase their utilization and thus reduce the excessive use of energy by achieving the maximum utilization of natural lighting and ventilation according to the function and nature of the building. In addition, suitable internal spaces and openings are distributed, including lighting and ventilation sound.

B. The principles of residential building design from traditional architecture to meet climatic requirements

- Using the internal courtyard style of buildings provides optimal comfort for the thermal environment [16]. The inner courtyard is a temperature regulator inside the building throughout the day and night. In the dry, hot areas, adding a pool of water and landscaping with trees helps moisturize and reduce the atmosphere's temperature.
- Using solar shading systems to eliminate the penetration of solar radiation into buildings. The facades of buildings can be protected by using high-performance glazing, Concrete and cement-based materials, metal structures, or sun breakers. These systems should be well designed to provide protection from excessive solar rays, reduce the resulting glare, and reduce heat gain to one-third.
- Using wind catchers in dry, hot areas makes it easier to ventilate interior rooms where the air is hard to reach from outside windows.

C. Sustainable development aspects of social and economic factors

- The dwelling occupants' social conditions must be considered to achieve privacy and provide all their needs regarding space, calmness, and quietness in housing.

3. Building materials with excellent and sustainable environmental impact

- Using sustainable local materials such as natural stones and clay saves energy in manufacturing, transportation, and installation. However, it requires further research. Local raw materials are suitable for climatic conditions, act as thermal insulation, and help control humidity levels, not to mention ease of use.
- Great care should be taken to select the appropriate natural materials for the walls and to choose a thickness that suits their physical properties regarding thermal conductivity, thermal resistance, thermal permeability, and reflectivity of light. The flow of heat from the outside to the interior depends on the thickness of the wall, its material, and the difference in external and internal temperature.

FINDING AND CONCLUSION

FINDING

The research study in the theoretical part dealt with the architectural design and history of the Hejaz region's residential buildings. Also, the factors which influenced the types of heritage houses in the Hejaz region of Saudi Arabia, the most important of which are the climatic, social, and environmental factors. The Hejaz region includes many cities, including Mecca, Madinah, Jeddah, and Taif. Different designs characterize residential buildings that date to the Ottoman period in each city because of the difference in climatic conditions.

The analytical study covered the various residential buildings in Hejaz (Western Region) in the Kingdom of Saudi Arabia. The region's climate is divided into hot, dry, and humid climates due to the region's expansion from the Western Sahara to the Red Sea coast. Based on the above analysis, two types of buildings are identified. In areas of hot, dry climate, the inner spaces in the residential buildings must be around the inner courtyard. The architectural elements correspond to the dry, warm climate, such as in Mecca and Medina. On the other hand, coastal areas with wet, humid climates show non-courtyard, high-rise four to five-story buildings which depend on cross ventilation and covering the facades with different perforated shades of different shapes.

CONCLUSION

This study helps to preserve the design identity dating back to the ancient Islamic periods. It also highlights the essential characteristics of architectural design, urban fabric, and important architectural

systems that can be used in contemporary designs to keep up with modern times. We must study the climatic environment when designing residential buildings in Islamic cities and seek to adopt the vocabulary of architectural heritage and design methods used previously. Additionally, we should try to develop technology to keep pace with the times while considering that environmental privacy is one of the essential elements of life in our Arab Islamic community. Using internal courtyards and wind catchers for ventilation and covering external openings with perforated elements helps to improve the ventilation of the interior spaces. Through sustainable design process indicators, sustainable constructions provide environmental solutions and treatments that achieve the highest thermal comfort for space users with the lowest energy consumption. At the same time, they attain countless economic benefits at the individual and community levels. The development of architectural education, academic study, and attention to environmental culture can play a significant role in creating a generation of architects aware of available products in global architecture and the resultant benefits of ecological conditions caused by them.

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