Chapter 8
Traditional Dwellings in Four Middle Eastern Cities: Adaptation Strategies to Harsh Climate in Privacy

Hirou Karimi, Mohammad Anvar Adibhesami, Maryam Ghasemi, and Borhan Sepehri

Abstract Climate change is one of the most serious environmental issues of the twenty-first century, compelling designers to adapt their work to completely new climate-change-adapted settings. The Middle East's dry environment causes issues with rising temperatures and decreasing humidity. Environmental harmony has long been a priority in Middle Eastern architecture. Designers changed nature to accommodate the limited supply and demand for energy. Concerns about privacy and climate change influence home construction in areas with similar religious and climatic conditions. As a result, the purpose of this research is to look into the environmental and privacy-enhancing characteristics of historic and contemporary buildings. To accomplish this goal, observations and reviews of relevant literature were used to collect qualitative data. Analysis from a variety of research and climate-tested data was used in the following: This study's data and analysis include traditional homes, the Koppen climatic classification, and contemporary house design. Furthermore, research methods have been used in areas with well-established internal residential characteristics, such as Baghdad, Riyadh, Mukalla, and Kashan. The climate and isolation of each instance were studied and compared to nearby, modern dwellings. Our data show that these communities' older buildings made good use of natural heating and cooling resources. Summer and winter rooms are available for rent in historic mansions in Kashan and Baghdad. Summers in these regions are scorching, and winters are bitterly cold due to the different positions of the sun. We have not yet investigated any sun-facing locations in modern architecture. Wind turbines are

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also very important. The wind tower passively cools the structure's air. In modern homes, air conditioning provides ventilation. These items are both expensive and energy-intensive.

Keywords Traditional architecture · Climate adaptation · Urbanism · Middle East

1 Introduction

People have attempted for a long time to live harmoniously with nature (Raja, 2018). Nature's quirks confine human behavior, forcing humans to adapt to new environments. People minimize clothing and shelter to live (Boyd & Banzhaf, 2007). Due to environmental forces, humans have outdone and surpassed their natural counterparts. People have developed dwellings for many climates throughout history (Moser & Ekstrom, 2010). Since prehistoric times, the local climate and features have influenced housing design. Traditional buildings' climate and privacy are examined. In the past, limited energy led designers to use natural materials. Traditional homes prioritize passive heating and cooling (Ding, 2020). Even in Islamic climates, different styles arise. Modern design ignores power and water since they are so plentiful. Designers no longer prioritize energy efficiency, leading to unsustainable buildings (Thébault & Fontaine, 2010). Environmental issues are gaining widespread attention. Climate change, fossil fuel use, and waste accumulation are environmental issues. Traditional building design prioritizes individual interests. This involves home comforts. Because of this, it is crucial to examine the home designs in the historical context of the cities that have made adaptations to their local climate. This study also addresses a significant topic. Throughout history, a number of Middle Eastern towns have featured architectural designs that work with the region's hot, dry climate. In this regard, by examining the housing layouts of Kashan, Makla, Riyadh, and Baghdad, this study has attempted to highlight the characteristics of these cities that are compatible with climatic circumstances on a private sector scale. These cities' old structures are still present and unrenovated, which is arguably one of their most significant characteristics. The private sector, which has made an effort to conserve these tissues, is to blame for this. For modern urban policymakers, architects, and urban planners, the knowledge that the findings of this research provide concerning the suitable housing patterns of these four cities can be valuable. They might be extremely helpful in combating the current era's climate change by offering strategies that are in line with local climatic conditions and scaled for the private sector.

2 Background Knowledge

The most comfortable and environmentally friendly forms of indigenous architecture are traditional homes that have been adapted to the local climate (Wiranti et al., 2019). Studying the history of traditional architecture and figuring out what makes traditional house designs in different climates unique can help solve many problems (Shahamat, 2014). Traditional homes, especially those in desert climates, use passive ways to heat and cool that work well (Kim, 2006; Li et al., 2021). One of their most significant features is that traditional homes block the sun in the summer and benefit from it in the winter.

In traditional architecture, the first stage in creating a traditional home is to identify the crucial elements in climate-related problems and potential solutions in the chosen geographic area (Al-Ban, 2016). Examining climatic data and bio-climate graphs in the suggested region is required. To make sure buildings are comfortable inside, it should be looked into how the local climate affects how they are built (Ding, 2020).

Each district's traditional architecture is based on local demands and lifestyle. Geographical, climatic, local resources, and cultural factors affect building design (Ejiga et al., 2012). Climate and culture affect how indoor and outdoor spaces are built up and connected architecturally (Daoudi et al., 2019). Wind, sunshine, precipitation, humidity, temperature, and air pressure are climatic elements that affect a building's design, construction, and alignment (Barati, 2005). Sunlight is the principal heat source in hot climates. It's crucial to position and orient buildings according to the sun's path. When designing a site, consider the direction of hot gusts. Both the hot and cold seasons highlight these two issues. Well-designed homes heat and cool more efficiently (De Joanna, 2016). The climate determines the building materials used. Options are limited by surrounding options. Each space should use widely available, climate-appropriate materials. Heat resistance and heat capacity are essential physical qualities. Many climates call extreme weather "critical times." Deserts need hot days, for example. So, in these situations, the materials should be good for hot weather so that outside air doesn't affect indoor air. BWH's day-to-night temperature range is large. The most-used rooms should be insulated with dense materials. For nighttime use, consider light, low-heat materials. Stone works well in dry settings because it resists and retains heat (Lang, 2013). Thermodynamics says heat goes from warm to cold. In arid regions, walls warm up during the day and absorb heat into the stones. At night, when it's cold inside, this heat is conveyed. Inhabitants' inner walls are cold during the day and warm at night, making inhabitants comfortable (Almatarneh, 2013). Traditional design uses two main materials: Thermal and solar efficiency of walls and finishes is one. Second, materials' self-efficiency. Traditional construction in hot, arid settings uses stone, adobe, muck, soil, and muck blocks. These materials' thermodynamic qualities make them ideal for desert climates with hot days and cold nights. High thermal capacity and heat isolation are needed. Mud's light tint reflects the sun's rays and traps heat at night (Daoudi et al., 2019). Climate affects

a building's energy efficiency and usage. "Green design" is sustainable. Climate-related concerns abound. These include making a house that is comfortable, healthy, and sustainable, as well as making good use of natural resources and energy (Baptista, 2019; Feitelson & Tubi, 2017).

3 Climate-Resilient Strategies and Implications at the City Scale

3.1 Kashan

Kashan is considered one of the ancient cities of Iran. Geographically, a total area of about 9,647 km^2 is covered. Isfahan is the name of this sub-province, which stretches from the Central Desert in the east to the Karkas Mountains in the west. One of the cities in Isfahan is Kashan. Kashan is located at (33°59′ North, 51°27′ East) and 982 m above sea level. Kashan is influenced by the desert climate. In Kashan, there is virtually no rainfall during the year. This location is classified as BWh climate (Köppen-Geiger). The average temperature in Kashan is 19.5 °C and ∼128 mm of pre cipitation falls annually. The highest and lowest average temperatures are in July and January, at around 33.2 and 5.0 °C, respectively. The average annual sunshine in Kashan is 2,942 h (Teshnehdel et al., 2020).

3.2 Impact of Climate Issues in Traditional Architecture in Kashan, Iran

In Kashan's historic homes, a number of architectural techniques were used to regulate the temperature and lessen day-to-night fluctuations. The primary component of the thick, heavy walls is mud blended with straw and adobe (Hosseini et al., 2020). The walls transmit solar energy at night after absorbing it throughout the day (Mirzaei et al., n.d.). The courtyard is surrounded by thick, towering walls that offer shading for the inside area (Leylian et al., 2010). The pond and the vegetation are in charge of cooling and raising the air's humidity (Tahbaz et al., 2022). When a result, ventilation occurs as the air cools by flowing through the yard and over the porch and tree (Eskandari, 2011). In this hot, dry climate with sparse vegetation, the courtyard serves as the social hub of the buildings. Usually, the courtyard was constructed below the ground level. The pond in the middle of the courtyard contains water for aesthetic and air-conditioning purposes. Because Kashan is in a dry area, water resources are taken into consideration when designing the home (Farshchi et al., 2016). It is necessary to dig the ground in order to find water supplies because of this. To add moisture, it is also possible to direct the air over a pond or cistern.

The variation in temperatures affects how the function works. One would wonder how a wind catcher functions when the wind blows slowly. In actuality, air flow is caused by the difference in temperature between the two sides of the hole. The wind catcher is warmer than the air in the veranda space due to sunlight exposure on its southern face. As a result, the heated air is drawn out of the area under the wind catcher by a form of vacuum. In order to make up for this, an airflow is created, bringing the cool air from the northern side of the home inside the building (Fig. 3). The temperature outside starts to drop at night. As long as there is a temperature difference between the outside air and the walls, cold air flows down and cools them (Barati, 2005; Leylian et al., 2010). But typically, the day starts and the wind catcher begins to function as it should before it reaches this equilibrium (Mirzaei et al., n.d.). A semi-private space through a hallway. The semi-private room and the private area are separated by a lengthy hallway. The layout of this building is intended to maximize seclusion while still promoting friendliness and social interaction (Barati, 2005; Eskandari, 2011; Karimi & Hosseini, 2012; Tahbaz et al., 2022). Another environmental condition that affected Kashan's housing plans during the story was the shedding and sunlight effect on people's comfort based in public and semi-public spaces. Few studies address the beneficial effect of shading and sunlit in courtyard houses on the thermal performance of residential buildings, particularly in a hot desert climate (BWh) (Teshnehdel et al., 2020). By looking at Kashan traditional house plans it can be understood that most of them are for better performance in cooling and shading factors designed as courtyard houses. In general, by examining the structure of the historical context of Kashan, it has a dense urban context and the houses that are compressed together have integrated walls (Karimi & Hosseini, 2012). It is suitable for insulating houses against extreme heat and cold, and it also plays a positive role in providing shade in alleys and passages (Akbari & Teshnehdel, 2018). In short, research shows that houses with courtyards in the urban structure of historical cities in the center of Iran, such as Kashan, have played an important role in reducing environmental challenges (Memarian & Brown, 2003).

In a research conducted by Behbod et al., design strategies responsive to the climate in hot and dry areas of Kashan city were presented. They identified the design features of the historical context of Kashan in 3 scales, macro, medium, and micro; In the first level, distance between buildings, enclosed urban environment and narrow and irregular streets were considered as macro strategies. Review and development of these traditional urban patterns should be considered in hot and dry cities. Medium scale strategies cover building form, building envelop, self-efficiency in materials and optical and thermophysical properties of building envelop in this paper. Sustainable architecture force us to re-think what we do and synchronize traditional methods of construction and the use of domestic materials. Finally, micro scale strategies demonstrate some more relevant architectural design methods which are the same as contemporary passive systems. As an illustration, old wind-catchers have been developed into advanced passive cooling systems in recent years. Consequently, consideration and development of the above strategies allow contemporary architects and designers to build contemporary architecture in a more sustainable, comfortable and self sufficient way (Behbood et al., 2010).

It should be pointed out that due to the integrated climatic conditions of the center of Iran, many of the architectural features and traditional urban planning of Kashan city are similar to other historical cities such as Shiraz and Yazd. The climate of most of the central plateau of Iran is hot and dry, and many historic cities that have valuable architectural designs are located in this hot and dry region. In general, the structures of this region are logically integrated with nature, and as a result, traditional Iranian buildings, unlike most modern buildings, are compatible with natural conditions and have a harmonious relationship with them. The most oppressed deserts in the world are located in the center of the large and closed Iranian plateau (Keshtkaran, 2011). Finally, it can be said that the traditional architecture and urban planning of Iran are largely related to the principles of sustainability, and in this regard, the importance of studying urban housing plans such as Kashan from the point of view of climate adaptation doubles (Figs. 1 and 2).

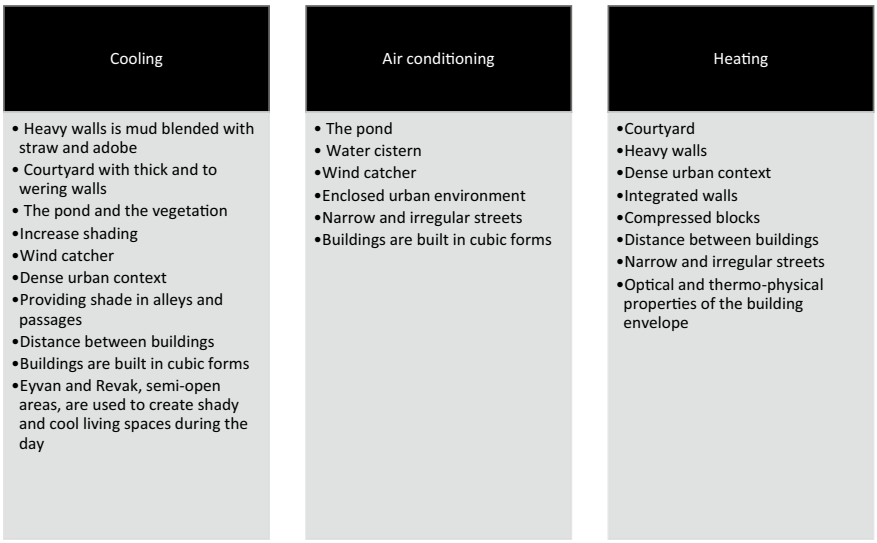

Fig. 1 Climate challenges and traditional solutions in Kashan

Fig. 2 Historical urban quarter of Kashan city (Based map from Google Earth)

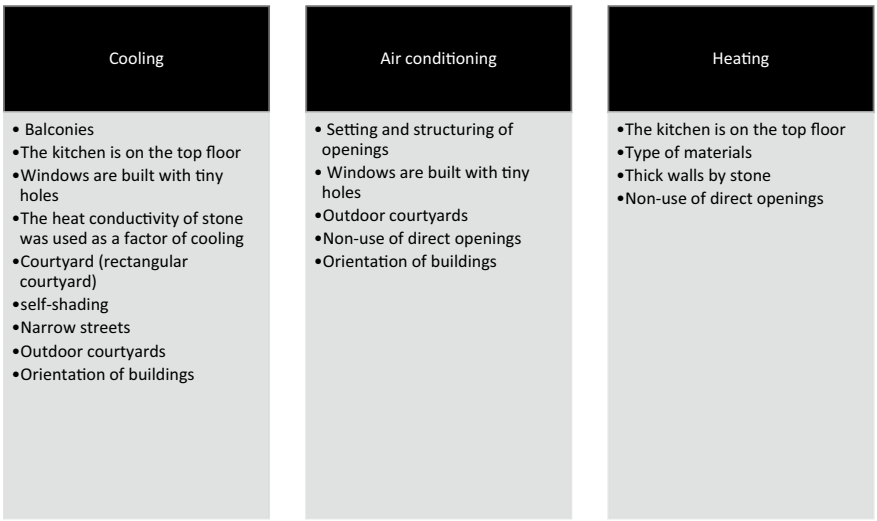

Fig. 3 Climate challenges and traditional solutions in Mukalla

3.3 Mukalla

"Yemen is located at the southern part of the Arabian Peninsula". North Yemen and South Yemen were two separate countries; they unified on the 22nd of May 1990 under the name of Republic of Yemen. Since then, Hadhramout is the largest province of Republic of Yemen. This city is situated in the southern part of the country. Also, Coastal Hadhramout is located between the Indian Ocean in south and the plateau in north. Mukalla is placed there. The coastal belt is over 350 km long. Over years, Mukalla is turned to be the largest and the most important city of the coastal Hadhramout (Al-Maashi, 1998). The city of Al-Mukalla is located in the coastal region, at an altitude of 14°5′ north and a longitude of 49°20′ east, and it enjoys a pretty Yemeni-like climate, very similar to other coastal towns in Hadhramout. In the summer, the day temperature reaches 32 °C and while relative humidity might increase to more than 80% (Baangood & Hassan, 2010). The four ancient quarters formed the center of the city and appeared in various local style architectures, interfaces, decorations, and a variety of vocabulary of architectural elements that may differ from one region to another. The influence of Indian, Asian and Turkish style patterns also appears in its public and private buildings. It is more common in vocabulary. Vocabulary and visible elements of the building in the facades, the existence of a strong architectural experience in providing solutions for ventilation and privacy, define the requirements of its society, which creates an extraordinary mental and aesthetic image of the beautiful city and its buildings (Khaled et al., 2016).

3.4 Impact of Climate Issues in Traditional Architecture in Mukalla, Yemen

The fundamental goals of traditional architecture in Mukalla are practicality, cultural sensitivity, and resident demands. The following are some of the key design elements: In order to give families a cool, private place to sleep during the hot summer nights, balconies were created. Additionally, a unique area is available for celebrations. Also, the kitchen is on the top floor so that the heat and smoke from cooking don't spread to other parts of the house (Baeissa & Hassan, 2011). As many openings or windows as possible, spaced no more than 30–60 feet apart, are produced on the walls of rooms. The vertical length of the windows is roughly 182 cm, and they are positioned 30 cm above the ground floor. These sizable apertures make it simple for air to enter the structure. To facilitate ventilation, windows are built with tiny holes. There is a constant flow of air as the warm air rising is sucked out through these tiny apertures.

The scorching weather was taken into consideration when choosing materials and how to use them in the construction. Stone is employed because it has low heat conductivity and can store heat energy. Particularly on lower floors, walls are erected with a thickness of 30 to 60 cm. As a result, interior rooms see less heat buildup on hot days. In addition, the building's massive stone walls keep internal heat from escaping at night when it is chilly (Baeissa & Hassan, 2011). A natural solution of the heat issue was solved by the kind of materials and the way they are used. The heat conductivity of stone was used as a factor of cooling the interiors of those houses. Building thicker walls enforced this character of stone. The thicknesses of walls (as thick as two feet at lower levels) allow smaller amounts of heat to penetrate to the inside of the building. Also, if it ever gets cold, the walls wiU keep the warm air from escaping through them (Al-Maashi, 1998).

One of the most important solutions to deal with climate challenges is the design of courtyard-oriented housing in Mukalla city. The courtyard has different shapes to provide more ventilation and thereby help to reduce the outside air temperature. The most used in Mukalla city is the rectangular courtyard, so self-shading of the courtyard reduces the need for cooling by about 4% on average (Baangood & Hassan, 2010). Also The results show that in general the air temperature in traditional houses is lower than the outside air temperature and in some cases the air temperature is within the thermal comfort range of Hadhramout. Comparing the results of the air temperature inside the courtyard shows that with the increase in the ratio of the dimensions of the courtyard, the air temperature also increases (Abdulla Binthabet, 2007). Research conducted by Rasha Saeed Baangood and Ahmad Sanusi Hassan revealed more facts about the traditional architecture of Mukala city. They showed that the Mukala city housing scheme uses narrow streets and outdoor courtyards to control air temperature and shading percentage by increasing wind speed outside the courtyard and narrow streets that integrate into the building. Also, the non-use of direct openings in the first and second layers of the building has helped to control the wind speed, and the courtyards and passages have been used as ventilation.

Fig. 4 Historical urban quarter of Mukalla city (Based map from Google Earth)

This research showed that the orientation of buildings in Mukalla city was useful in providing natural ventilation and was involved in temperature control (Baangood & Hassan, 2010). But on the other hand, we see the excessive use of glass in the design of traditional buildings in Makla, which researchers show that due to the climate changes of the last century and the increase in sunlight, the excessive use of glass should be reviewed (Figs. 3 and 4). They found the solution. Returning to the traditional architecture of this region, they see that the openings were indirect (Al-Sagaf, 2009).

3.5 Riyadh

Saudi Arabia has experienced rapid growth in urban development during the last four decades with the city of Riyadh transforming from a mud-walled town of 25,000 inhabitants to an international metropolis of 2.5 million. The city belongs to the pre-Islamic era and has transformed over time with rapid urban development. Since the 1940s the city has changed from an isolated and narrow town to a spacious modern city. It lies in the centre of Arabian Peninsula on a plateau with an area of around 1300 sq. km (Dhingra & Chattopadhyay, 2016).

The city is located 240 miles from Dammam on the Gulf and 530 miles from Jeddah on the Red Sea. Riyadh, the Kingdom of Saudi Arabia's capital, has a sizable population. This city may be found in Najd. With an elevation of 600 m above sea level, Najd is a remnant fiord. Due of the fine subterranean water, it is extremely abundant despite the area's dry climate (Ragette, 2003). Riyadh's climate tends to be uniform, dry and hot during the daytime and cooler at night in summer; in winter, nights tend to be cold and days are warm. Daytime temperature can reach 45 °C or more in summer and be as low as 1 °C at night in winter. Rainfall is very low in Riyadh; the rainy season is from December to April, with an annual average of 100 mm (Al-Hemaidi, 2001).

3.6 Impact of Climate Issues in Traditional Architecture in Riyadh, Saudi Arabia

In general, the housing plan of the traditional neighborhoods of Riyadh should be considered as the type of Najd region. A Najd vernacular house can be typified as square or rectangular with rarely more than one floor. Rooms are arranged around the central colonnaded courtyard and have small windows. The adobe walls, floors and roof are between 50 and 80 cm thick, or sometimes even more (Alrashed et al., 2017). In Riyadh, the courtyard inside the home plays a significant role in improving the climate and offering seclusion. Most of the time, the yard's height and size, as well as how important it is, depend on where the house is and who designed it. Traditional homes in Riyadh had roof-top porches for cooling off on hot summer nights. On the first level, there is typically an open space that serves as a living room in the spring, summer, and fall. A wooden platform is built out of caution above the house's entryway. Close to the ceiling of this building, small wedge-shaped holes are cut out to help with ventilation. The alleyways are small, and the outer walls are high for privacy reasons. This arrangement creates a structure shaped like a ditch and offers the most shade. Because of the bright sun, the temperature in places with shade and places without shade is very different (Akbar, 1980).

In Riyadh, The hot and dry climate, along with the need to separate private spaces from semi-private and public spaces, led to introverted urban plans (Dhingra & Chattopadhyay, 2016). The building plan of Riyadh city is such that the buildings are closer to the ground and are placed together to create a cooler environment. On the other hand, having houses with courtyards and ventilation spaces on the upper level caused hot air to rise and convection currents near the ground to cool. Air towers and inner courtyards are used to increase ventilation and cooling, and mud was the most important material that played a role in keeping the house cool (Abu-Ghazzeh, 1997; Dhingra & Chattopadhyay, 2016).

The typical houses of Manjed region (Riyadh) are introverted type, the houses are built around one or more courtyards, which are usually square or rectangular in pure geometric shape. The courtyard element in the design of Riyadh houses plays two roles: regulating the small climate and preserving the privacy of family life. As a microclimate regulator, the courtyard creates three cycles of air movement in the house, which creates an optimal level of comfort for the residents. The outer walls of the houses were made very thick to act as insulation against the intense summer heat. Also houses are generally arranged around courtyards that act as lungs of the houses to regulate the micro-climate even, houses are compactly designed to play an important role in shading and reducing heat and sunlight (Figs. 5 and 6). The use of small openings in the walls to maintain the airflow is also considered one of the distinctive features of the designer of the traditional houses of Riyadh (Babsail & Al-Qawasmi, 2015).

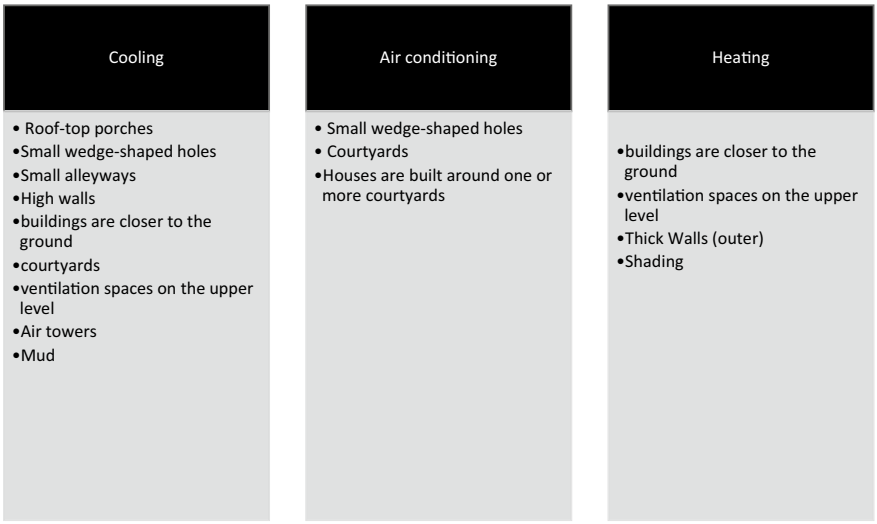

Fig. 5 Climate challenges and traditional solutions in Riyadh

Fig. 6 Historical urban quarter of Riyadh city (Based map from Google Earth)

3.7 Baghdad

Baghdad's countryside is flat. The city has a sedimentary structure and is situated at a low elevation above the ocean "The River Tigris cuts across a broad plain where the city is situated. Baghdad is divided in two by the Tigris, with the western half known as 'Karkh' and the eastern half known as 'Risafa.' Due to the frequent, significant flooding that has occurred on the river, the terrain on which the city is built is nearly entirely flat and low-lying and is therefore alluvial in origin."

3.8 Impact of Climate Issues in Traditional Architecture in Baghdad, Iraq

Thermal comfort is achieved in traditional Baghdadi homes by making efficient use of available space and selecting the appropriate materials. Sunlight and clean airflow are provided through the central courtyard. In the courtyard, children were playing on a daily basis. The courtyard was successful in adjusting the interior microclimate of the house in Baghdad's extreme weather, which is characterized by lengthy hot days in summer, extremely high temperatures, a broad range of daily temperature fluctuation, and low humidity.

In actuality, the yard controls the temperature. In hot, dry areas, courtyards typically play a significant role in lowering summertime interior temperature. It runs on the principles of convection and radiation, two thermal processes (Goodwin, 1985). The porch and the courtyard's ground serve as intermediaries between the chilly sky and the warm interior, with the chilly area rising at the highest point. Two distinct microclimates were created inside the house, thus the family typically moved from one division to the other as the seasons changed (Agha & Kamara, 2017). The courtyard is the home's breathing structure, controlling the temperature and supplying ventilation. In order to offer shade in the yard, there are typically sunshades or trees. There are also ponds and fountains to add moisture on dry hot days.

South-facing "Iwans" and "Tarma" (varieties of porch) were used in the winter since the sunlight warmed them. In the summer, the household relocates to cooler areas like the basement because these areas are warmer. According to Warren and Fethi (1982), the ridge and courtyard ground have very different temperatures. The courtyard ventilates all staircases perpendicularly. The upper levels are hot and uncomfortable in summer (Jasim, n.d.). The cool basement has a water storage cistern, or "Sardab." The "Talar" and "Ursi" sections orientated south or west were not occupied, even at the courtyard level, because the afternoon sun made them too hot (Al-Azzawi, 1996). Shanasheels can let air through. When the sliding belts are open, air flows freely across the window. Shanasheel has another cooling function: as these windows are made of wood, sunlight would warm the air near them. The rising hot air naturally cools the room. "Shanasheels" provide daylight and fresh air. The street-facing ground-floor walls are made of lumber. The Shanasheel, Ursi, and interior panels are glazed and latticed. These walls have a high heat conductivity, so rooms on this floor are rarely utilized in the summer (Allan, 2012). Three-fronted dwellings are densely packed. A thin passage between them shades the street-facing front of the house. Masonry walls help regulate the home's temperature (Warren & Fethi, 1982). Baghdad's scorching summers make the shade a must. The residences' principal courtyards had sunshades. The scorching summers in Baghdad necessitate the use of shade. Therefore, the principal courtyards of the residences are equipped with sunshades to provide relief from the heat. As a result, the courtyards are cooler and more comfortable on hot summer days. This practice of providing sunshades

helps to mitigate the effects of the extreme heat in Baghdad, making outdoor spaces more habitable during the summer months.

A high-columned awning called "Tarma," which is positioned around the rooms on the ground floor, is another mechanism for raising the temperature. This structure keeps the chamber from getting direct sunlight from above in the summer (Figure 13; Warren & Fethi, 1982), but it doesn't have much of an effect on the low-angled sunlight in the winter.

Ventilation or providing air movement is also an important factor in providing comfortable weather inside the house. Ventilation is implemented by shades, openings and lattices. But there is another effective mechanism for efficient ventilation which is called "Badgir" or air-scoops. In traditional Baghdadi houses, "Badgir" is an important discriminative item. This item has been specifically designed to capture the dominant north-western winds in Baghdad region. The air is vacuumed down to the room through a tube. This air has been cooled when it passed this shaft before reaching the down. Although the temperature would be greater than the air temperature of the basement and this is less humid, still waving out the air from the room will take out the exhausted air and improves the atmosphere. Without Badgir the rooms in the basement are cold and unpleasant during the winter. But, the shutters of "Badgir" which are openings to the outside air carry warmed air into the space and enhance the temperature of basement space.

The "Badgir" ventilation system, which is used in Baghdadi traditional homes, was mentioned in the previous section. These air scoops supply fresh air flow to the basement and semi-basement regions. This architectural feature has a vertical duct with a substantial external thickness. The roof-top entrance of the vertical shaft is integrated into the bulwark wall. The basement and semi-basement are both accessible through the scoop's outlets, in addition to Talar. Talar may feature multiple air-scoops due to its size.

Shade, the choice of materials, and air flow are the three most important things in the design of the house that affect the climate. The house's orientation is crucial because it creates microclimates in various areas that the family may move to as the seasons change. Living arrangements alter around September or April. As winter began in September, the family relocated to south-facing rooms with more heat and sunlight. On the other hand, they relocated to the northern rooms around April or May. Daily living space and sleeping space differ during the summer. The family spent the day in the lower-level areas before moving to the roof porch at night (Figs. 7 and 8). So, on hot summer nights, the roof doubles as a bedroom. Additionally, three frontages connect the residences, acting as a heat buffer (Figure 15; Warren & Fethi, 1982).

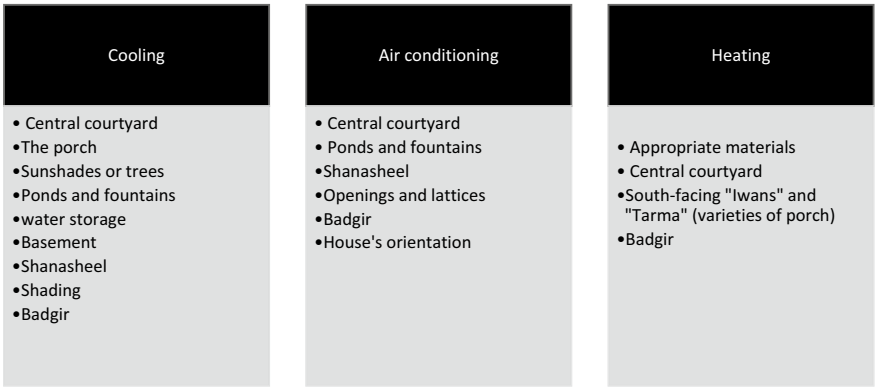

Fig. 7 Climate challenges and traditional solutions in Baghdad

Fig. 8 Historical urban quarter of Baghdad city (Based map from Google Earth)

4 Discussion and Implications

In this study, the research was conducted based on the following steps: Firstly, the study is organized according to the aim of the research. An investigation of the problem needs to identify information resources and collect them. Afterward, data is collected based on the qualitative procedure. The literature review is completed based on books, scientific journal articles, thesis proceedings, and websites. The field study in Kashan is analysed based on the observations and the author's impressions and written data. Finally, the collected data is analysed, compared, and discussed with regard to the purpose of the study. Table 1 shows the results of an analysis done on both of these to learn more about how climatic architecture works in both traditional and modern settings.

A close examination of Table 1 reveals several important findings of this research. First, by comparing the features related to the climate factor of contemporary and traditional architecture, it is realized that in the Middle East, with the expansion of urbanization and the need for rapid urban construction and development, factors such as climate conditions and energy are ignored. This fact can be understood when we consider the four cities studied in this research as many cities in this region. So, it is shown in table one that many features of native architecture and urban planning in the Middle East were victims of the rapid and affordable development of the modern

Table 1 Features of traditional and contemporary architecture in selected cities with regards to climatic factors

Cities	Feature related to climatic factor in traditional architecture	Feature related to climatic factor contemporary architecture
Kashan	1. Water and trees and mud-brick for evaporative cooling in a courtyard (Rahmi, n.d.) 2. Shaded areas in the courtyard (Ivan) (Naseri & Farsani, 2022) 3. Surrounding the courtyard with high walls reduced the floor warmth (Eskandari, 2011) 4. Using open areas during the day (Leylian et al., 2010) 5. Summer and winter rooms (Naseri & Farsani, 2022) 6. Using Badger as an element for cooling (Farshchi et al., 2016)	1. Contemporary Buildings has no specific orientation (Diba, 2012) 2. Using mechanical and electrical systems for cooling and heating and also makes located kitchen near living spaces but in small size (Daneshjoo & Farahani, 2013; Shirazi et al., 2018)
Riyadh	1. Traditional house has a private courtyard for thermal comfort (Yakovlev, 2021) 2. The houses are close to each other (ʿUthmān, 2020) 3. The streets are so narrow to protect from the straight sunlight (Al-Solaiman, 2022) 4. The windows are protected and called Mashrabieh (Al Asadi et al., 2020) 5. Roof-top porch on hot nights of summer is used for cooling (Al-Ibraihm, 1996)	1. They are semi-detached or detached building and exposed to sunlight (Al Asadi et al., 2020) 2. The openings are not protected, which is against the rules for climatic matters (Al-Saif, 1994) 3. The design of the window is useless, and they use mechanical and electrical elements such as fans and ACs for thermal (Sayigh, 1981)
Mukalla	1. Main material is stone, and there are wooden grids (Khaled et al., 2016) 2. Roof terrace for sleeping in hot summer (Nasser Barashed & Essa, 2008)	1. The primary material for contemporary construction is reinforced concrete (Nasser Barashed & Essa, 2008) 2. Using an electrical and mechanical system for cooling and heating (Baangood & Sanusi, 2017)

(continued)

Table 1 (continued)

Cities	Feature related to climatic factor in traditional architecture	Feature related to climatic factor contemporary architecture
Baghdad	1. The house separated between the summer part and winter part (Hasan & Hassan, 2020) 2. Courtyard has the thermal function in the house (Al-Saffar, 2020) 3. Takhtaboosh, tarma, is for thermal comfort in traditional houses (Akram et al., 2016) 4. Badger is an element for cooling the basement for summer (Khaled et al., 2016; Ramdan et al., 2020) 5. Roof terrace for summer sleeping (Khaled et al., 2016) 6. Shanasheel is used for cooling (Al-Hasani, 2012)	1. In front of the house is a garden which surrounds the house from one or two or three side (Hasan & Hassan, 2020) 2. The contemporary houses cooling and heating is by a ceiling fan, a liquid-cooling system (Al-Hasani, 2012) 3. Large windows without any protection (Al-Saffar, 2020)

world. However, this fact can be seen in the weakening of the identity and native culture of the Middle East on a large scale.

Second, Table 1 and even Figs. 2, 4, 6, and 8 show the strategies and design indicators of the traditional neighborhoods of the studied cities, which, despite the differences, many commonalities can be found. In the first place, this is due to the almost similar climatic conditions of the cities of Kashan, Mukala, Riyadh, and Baghdad, and in the second place, it can be caused by the common Islamic culture in these areas. As shown in Table 1, the courtyard, both centrally and externally, has been an essential element of traditional design and architecture in the Middle East. This research showed that in urban planning and traditional architecture of the Middle East, such as the cities of Kashan, Mukala, Riyadh, and Baghdad, courtyards are used to increase humidity, and ventilation and keep the environment cool. The importance and role of the courtyard in adapting to the climate of the traditional houses and cities of the Middle East have been presented in various research in support of this study (Abdulkareem, 2016; Ayhan & Neslihan, 2011; Bekleyen & Dalkılıç, 2012). Also, Table 1 reveals that in the foundation of the structure of the 4 studied cities, natural elements were of high importance. In fact, the traditional architecture of these cities, which is the result of years of experience and trial and error, has used nature itself to deal with natural challenges. Something that is no longer seen in the contemporary development of these cities. Using local materials, mud, using water (pond), and trees in the semi-private spaces of houses and controlling airflow is the most important way to get help from natural elements in these cities that this research found.

5 Concluding Remarks

The traditional architecture of these regions has been transformed into contemporary construction. This design typology does not match the weather conditions of these four cities. Passive heating and cooling strategies are also overlooked in contemporary architecture. Efficient designs such as implementing different spaces as cool and warm sections are not observed in contemporary homes. Therefore, ventilation in contemporary homes needs a lot of energy from fossil fuel resources. These days, the natural fossil fuel resources are being faced with being finished. It could cause a big problem for the humans who live in the world for a living. Our analysis declared that in traditional examples of houses in these cities, natural resources were effectively used for heating and cooling. For example, in traditional houses of Kashan and Baghdad, which were analyzed before, summer and winter living spaces are implemented. These sections have different orientations regarding the sun, which makes them cool during the summer or warm during the winter. In the contemporary architectural examples explained before, there is no specific solar-oriented space. Another essential characteristic is wind towers. The wind tower uses a passive mechanism to circulate the cooled air into the interior spaces of the building. Conversely, in contemporary homes, this ventilation is done by an air conditioning system using energy, so spending money is not affordable for everyone. Furthermore, the examples of traditional houses in Mukalla and Riyadh feature roof spaces to be used at night in summer for sleeping. Basements in Kashan traditional example and Baghdad traditional example have ponds, and they are used as cool spaces during the summer. Also, this research was able to show that there are many commonalities between the 4 studied cities in terms of design and policies adaptable to climate challenges, which are shown in Fig. 9. It should be added that the findings of this research can familiarize today's policymakers, architects, and urban planners with traditional useful strategies and strategies adapted to the climate and encourage the private sector to use them again. It should be added that the most important limitation that this research faced was the lack of information and related research in the cities of Mukala and Riyadh. Finally, it could be concluded that both climatic factors and privacy issues were considered in the design of traditional houses in the past. However, the pattern of contemporary homes is almost identical in all regions without considering such matters. People in the contemporary period need to reconsider their design style by using traditional design characteristics as a benchmark.

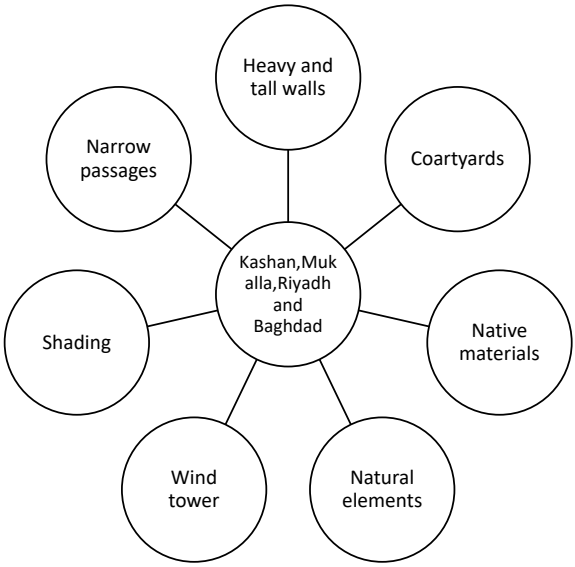

Fig. 9 Common Strategies and elements of adaptation to the harsh climate in the cities of Kashan, Mukala, Riyadh, and Baghdad

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