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The Vernacular Mosques of Al-Khabra in Saudi Arabia: Investigating Urban Architectural and Social Dimensions

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ABSTRACT

This paper presents for the first time the vernacular architecture, history, and architectural typology of the two mosques in Al-Khabra Heritage Settlement in Al-Qassim region in central Saudi Arabia. It analyses the urban role of mosques and associated social and cultural practices in terms of behavioural aspects not traditionally considered in terms of the role of such structures, particularly as a thermal comfort refuge during extreme heat. A sample of eight previous residents from the older generation who lived in the settlement before its population moved out in 1981 participated in semi-structured interviews in the summer of 2020, to collect valuable data about their experiences and memories of spatial practices of the two mosques. The findings revealed that the older generation had different comfort expectations than their descendants, and the recording of their comfort perceptions in this study is important. This paper addresses the gap about investigating residents' perceptions, behaviours, and cultural meanings of mosque spaces, and investigates the particular characteristics of mosque architecture in Al-Khabra, in comparison with those of other mud vernacular settlements in the same region such as Al-Tannomah, Al-Diriyh and Ushaiger. The findings reveal that people moved around the mosque to find suitable indoor environments in response to temperatures, exhibiting adaptive strategies. Furthermore, mosques served several expansive local needs, including social, cultural and environmental functions.

Keywords: vernacular mosques; behavioural adaptations; comfortable environment; mosque architecture; urban fabric.

INTRODUCTION

Vernacular mosque architecture in the Islamic world is a growing research field, but few studies have explored this in the Kingdom of Saudi Arabia (KSA), and the Arabian Peninsula in general. Vernacular mosques have never been considered from the point of view of their previous users. This paper presents for the first time the vernacular architecture of the two mosques in Al-Khabra heritage settlement in Al-Qassim region and analyses their urban role and associated social and cultural practices.

A sample of eight previous residents from the older generation of Al-Khabra Settlement (who lived in the settlement before its population moved out in the 1991) was interviewed in the summer of 2020. The semi-structured interviews were aimed at collecting valuable data about their experiences and memories of the spatial practices of the two mosques. The mosque is considered as a strong link between dwellings and between people inside and outside settlements. In addition to its primary purpose of accommodating worshippers for religious practice, the mosque served various social, cultural and environmental community needs. Given its religious importance and function, it plays an important role in the Islamic settlements. It is important to study the characteristics of the mosque in relation to the local socio-cultural, environmental and economic context.

Aside from early description of vernacular mosques in KSA were provided by Western travellers (King 1978, 1980). However, very few studies have been conducted since then on the vernacular mosques of Saudi Arabia, indicating a historical lack of interest among local scholars concerning their indigenous culture and traditions. However, there has been a recent renewal of interest in such heritage as indicated by the published studies of El-Johary (2008); Schiettecatte et al. (2019); Mahmoud (2021). The most recent initiative in that of Al-Fozan Award established in 2014 (see Historical Mosques in Kingdom of Saudi Arabia: Investigating Architectural Styles Typology | Abdullatif Al Fozan Award for Mosque Architecture (2019) via: alfozanaward.org). Various studies have been conducted on the architectural typology of mud brick buildings in vernacular settlements in Saudi Arabia. This is particularly the case of the Central Region (Shamekah 1975; Aldusari 1995; Eben Saleh 2001, 2002; Al-Hemaidi 2001; Al-Hathloul 2002, 2018; Mubarak 2004; Al-Nowaiser 2010; Alsheliby 2015; Bin Sulaiman 2017; Alnaim 2020). However, these studies do not provide any descriptions or analysis of the mosques in the studied settlements. Only two PhD theses could be found directly related to the mosque architecture and vernacular settlements of the Central region of Saudi Arabia known as the Najd region (Shamekah 1975; Alnaim 2020).

The initiative of Al Fozan is therefore addressing a real gap. No studies have been found on the social and cultural practices associated with the vernacular mosques. This paper addresses this gap as it investigates the lived experience of vernacular mosques in Saudi Arabia based on the memories of previous residents who used to live in heritage settlements where these mosques are located in the previous local residents of Al-Khabra, who are still alive and have been contacted by the researcher with the assistance of the Municipality of Al-Khabra. These considerations raise the following questions: what are the specificities of the vernacular mosque architecture of Al-Khabra as compared to other mosques in other mud brick settlements in centre KSA? How can the mosque inform future plans for the rehabilitation and restoration of historical mosques in the region or even new mosques by reproducing certain specific elements that are specific to the region? What was the historical role of the structures in local society, and what is their contemporary relevance? What are the contemporary challenges facing the reconstruction or rehabilitation of existing mosques in the KSA?

This research studies the architectural typology and history of two mosques of Al-Khabra village, looking at behavioural aspects which have not been considered in terms of the role of the mosque as a kind of thermal comfort refuge during extreme heat. Closer familiarity of researchers with researched issues concerning local environments generally yields more in depth results to understand complicated perceptions and performance under certain circumstances, especially with regard to occupant behaviours and other socio-cultural, physical and environmental attributes.

CONTEXTUALISING AL-KHABRA MOSQUES

Studies on Al-Khabra are very rare. Only one study was identified and dealt with the urban scale of Al-Khabra settlement without any information about the mosques (Al-Nowaiser, 2010). Furthermore, vernacular mosques have never been considered from the point of view of their previous users. The Central region of KSA comprising Riyadh, Al-Qassim and Hail known as the "Najdi style" has distinctive properties based on clay as the main construction material.

This paper aims to fill the knowledge gap about investigating residents' perceptions, behaviours, and cultural meanings of mosque spaces and investigates the particular characteristics of mosque architecture in Al-Khabra, in comparison with those of other mud vernacular settlements in the same region such as Al-Tannomah, Al-Diriyh and Ushaiger (Figure 1).

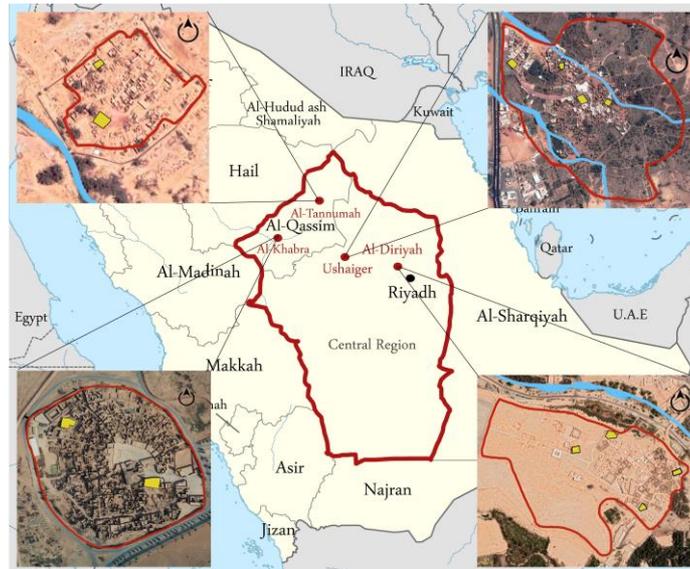


Figure 1. Location of Mosques in four mud brick vernacular settlements in KSA Central Region.

Al-Khabra, as with the other settlements, has two types of mosques, the large congregational mosque for Friday prayers and small neighborhood mosque for the five daily prayers. The other villages have one or two large mosques and several small mosques as is the case in Ushaiger and Al-Diriya (see figure 1). However, Al-Khabra and Al-Tannomah which are both located in Al-Qassim region have one mosque of each type. The examination of the mosques in each of the four mud vernacular villages of Al-Diriya, Ushaiger, Al-Tannomah and al-Khabra, reveals that mosques have many purposes, beyond the rituals of prayer. The two mosque types in villages represent an important observation that increase understanding of the concept of mosques, explicitly and implicitly, indicated by physical shape and areas served by the structures. This was illustrated in the following participant's observation:

" many activities were held in the large mosques, such as Friday prayer, a learning space for the community, general meetings and hospitality places for the guests to sleep". (Ali Al-Salamh)

As illustrated in maps shown in Figure 2, the large mosques where the Friday prayer is held are mostly located in the central areas of the settlements and close to the market "Souq", at the intersection of the main streets linking the main gates of these walled vernacular villages. On the other hand, the small mosques are placed in semi-public and private realm of residential neighborhood. The large Friday mosques are located in proximity to the large market areas or souqs, allowing both local people and visitors to use the mosque. This was observed by Doughty (1888:412):

"Their mosque stands by the mejlis, and is a low clay building. Neraby I saw a brackish well—only a fathom deep, where they wash before prayers... Mejlis is held in the Friday market when the nomads, come also to pray at noon in the masjid bringing camels, small cattle and samn (a form of butter)".

The Friday prayer as a weekly event brings together all members of the community, with an associated Friday market that would attract traders from the surrounding regions and provides the inhabitants of the settlement and its adjacent region with trade opportunities. Conversely, small mosques are devoid of connections to commercial functions, and are simply for the local people to perform their daily prayers in their neighborhood.

MINARETS

Minarets in the Central Region have a distinctive cylindrical funnel shape, reminiscent of the minaret of the Great Mosque of Samarra, with a raised head atop a bevelled or square base. The minaret is often located above the prayer hall with a staircase leading to it. Some minarets are very large with rooms used for additional prayer space during Ramadan. The minaret may be one of the main features that distinguish the Najdi mosque in particular. The region illustrates some observations and provide an interesting area of research for the scientific knowledge of those mosques. The latter have sometimes been mentioned in several studies but have not been the subject of intensive, detailed fieldwork analysis so far.

STUDY AREA PRESENTATION: AL-KHABRA VILLAGE

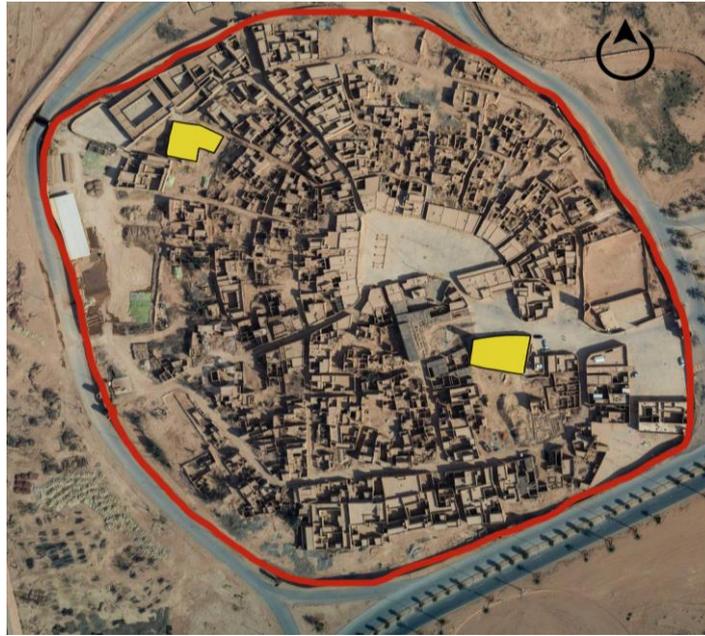


Figure 2. Image of Al-Khabra. Source: (Saleh Ahmad Al-Hathloul 2015)

Al-Khabra is a village located in the west of Al-Qassim region in central KSA. Surrounded by the Najdi desert, it sits atop massive aquifers, and it a fertile land capable of producing abundant vegetation and crops. It is commonly called the "bread basket" of KSA due to the availability of wheat. There are several valleys running through the region, the most important of which is Wadi Al-Rummah, where the settlement is found. The village is bordered on the south and east by the valley and mounds of sand and on the north and north-west by numerous farms.

Al-Khabra was described by Doughty (1888:411) in his book *Travels in Arabia Deserta* as:

"an ancient name of a principal oasis in the desert Al-Qassim. It is a naked clay bottom in the desert where shallow water is pounded after heavy rain surrounded by mud-brick fence. It has some butchers stalls and a smith's forge".

The standard of living of village residents continued for centuries to be based on agricultural prosperity with a rich urban fabric, manifest in safe walls, farms, spatial system, local resources, building orientations and inhabitant skills forming a liveable and interdependent local ecosystem with a sustainable economy.

The vernacular village of Al-Khabra has been standing in the Central Region of KSA for hundreds of years as an ideal example of sustainability. Al-Khabra is inclusive, protective, environmentally friendly, self-sustaining and embedded in its local context; its urban fabric and spatial system show exemplary integration, interacting with various inhabitant activities and the surrounding natural features (Alnowaiser 2010). The system spatially and behaviourally intermingles to facilitate different human activities within their corresponding domains in their local built environment. The spatial systems are based on an inclusive sustainability to achieve a living comfort zone and well-being. The level of sustainability has been expressed through supporting and maintaining inhabitants over many

centuries and generations. The village organization and its farms, streets, adjacent buildings, courtyards, local materials and water wells contributed to the sustenance of human life, culture and community.

There were three spatial phases manifest in housing styles, representing three remarkable developments of the settlement (Alnowaiser 2010). Firstly, the centre of the village with initial inhabitants and closest houses to the central place. Secondly the middle area with first immigrants and medium houses. Thirdly, the external area was inhabited by late settlers with the biggest houses in 1950.

The settlement is formed of many neighbourhoods, typically separated by streets. The neighbourhoods were directed inward to public plazas and dwellings were similarly focused around a central courtyard. This urban and domestic model provided residents with their needs for privacy, safety, security, social bonds, climate resistance and ecological protection.

The concept of urban fabric relates to the expression of spatial justice for everyone in the village from children to the elderly; consequently, the village is shaped by integrating spatial, behavioural and ecological systems (Al-Nowaiser, 2010). It exhibits many sustainable systems for social interactions, self-supporting services and economic activities. Al-Khabra was described by Doughty (1888:411) thus:

“The house-building of Al-Khabra is unplanned and the place is not unlike certain village towns of upland Syria”.

It had numerous defensive systems, including a perimeter fence around each side, with a number of watch towers and continuous external blocks with limited access points. The watch towers were often located surveying empty areas of open desert, with some towers placed to secure farms and overlook sand dunes positioned to the south and west. Sustainable protection from the environment was reflected in Al-Khabra's orientation and the design of buildings, streets, roads and neighborhoods, with continuous blocks from the south and south-east limiting the encroachment of sand dunes in these sides. Therefore, it is clear that long blocks help to block sand dune expansion from those directions.

The long blocks, closely clustered houses and the usage of mud as the major construction material reduced the indoor temperature of houses. Dwellings in the village shaded open spaces, streets and buildings most of the time, creating less sun exposure and direct solar heat gain.

Al-Khabra has four gates supported by long blocks to control outer access to settlements. Three main roads were built oriented externally to outside adjacent farms. These roads lead to the central area of Al-Khabra (called Al-Majles in Arabic), which was the main area for residents and visitors to exchange goods (mainly farm products produced locally exchanged with visiting merchants' wares). Traders arrived by camel as described by Doughty (1888:412) in the extract quoted above.

On the other hand, houses, plazas, streets and neighbourhoods were oriented inward in direction and each house was directed inward focusing around its central courtyard with monitored accesses and very few windows. In addition, houses had secure access to the inside, controlled via long blocks of housing with few outside openings, whereas the large openings were directed to the inside courtyards of houses. Cool air circulation was improved via narrow openings as illustrated in the following participant's observation:

“Windows in some places were at a high level of the external wall, whereas large openings were located in low level of the walls towards central courtyards for smoke extraction in winter and air circulation in summer” (Al-Hudaythi)

In mosques, small windows were typically placed in the upper level, while open central courtyards with no walls inside mosques facilitated air circulation. These methods enhanced cool air infiltration in summer and warmer air inflow in winter. As a result, these urban fabrics enhanced the spatial arrangements to be sustainable and secure.

DATA COLLECTION AND METHODS

This study was split to two (2) main phases, data collection followed by analysis. The first phase of the investigation attempted to collect data about the position of the two mosques in Al-Khabra. However, in the case of dilapidation or reconstruction of mosques structures, the study analysis was carried out based on fieldwork including observation. The history of the mosques was reviewed to inform the reconstruction of both mosques in Al-Khabra (the large and small Mosques described below) as collected from fieldwork calibrated with available historical sources. The data collection also relied on the oral memory of previous residents who are now elderly to give their voice on the memory of these places and to fill gaps in respect to the mosques. Consequently, the current study interviewed a sample of eight elderly local residents in depth who had experience of living in Al-Khabra vernacular houses. Therefore, fieldwork was carried out in July 2020. It is important to consider what people with lived experience have to say about vernacular architecture, because this can inform future practices, and avoid mistakes associated with academic abstractions and sheer ignorance of traditional ways of life.

The second phase of the investigation concentrated on urban fabric. Al-Khabra was compared with other mud-brick villages and mosques in the KSA such as Al-Tanomah, Al-Diriya and Ushiger, to combine the findings on all of these sites to draw some lessons for sustainability. The studied cases were purposively selected due to their manifestation of historical Najdi style of the 18th century, before the establishment of the KSA in 1932.

ABOUT THE MOSQUES: HISTORY, POSITION AND SCALE

The vernacular settlement of Al-Khabra was vacated in 1981 when the government bought all houses on the site and relocated people into contemporary houses. This left the houses empty, and the settlement was considered as a heritage site being rehabilitated for internal tourism. This was illustrated by a participant's comment:

“All the residents of the village left after the relocation of people into contemporary houses located nearby settlement, except some elderly people who refused to get out and stayed for a few years” (Ali Al-Salamh)

As these houses were vacated, the study relied on the oral memory of previous residents who are now elderly gathered via recorded phone and online interviews. The aim of the interviews was to investigate mosques, giving the voice of the elder generation who used to live in the vernacular houses before they moved to contemporary houses.

Fieldwork investigation of the chosen mosques is a beneficial method to fulfil the research objectives about investigating the characteristics of the two mosques which are significant in the development of vernacular mosques in the current search for a sustainable paradigm. Based on the available cases in Al-Khabra, two mosques were selected for the study. The “Large Mosque” is a larger complex near the centre of the village close to the Mejlis open space; the “Small Mosque” is a smaller structure close to the north gate in the north-west side of the village. The large Mosque has a basement known as the “Khalwa” means seclusion, and both have open central courtyards. The large Mosque and its surroundings were observed by Doughty (1888) in Al-Khabra, as described previously.

Prior to restoration efforts, the large mosque was in a bad condition, while the small mosque was still essentially intact, but it was not in use (Figure 3). Consequently, Al-Khabra Council in cooperation with the Tourism Ministry worked on the large central mosque and it has been rehabilitated, but not with its original features. A covered courtyard and single glazed windows have been introduced which are inefficient for energy because hot air is trapped inside (the vernacular open courtyard benefitted from air movement). These modern solutions will turn the space into an oven, with intensive heat gain and it is essential to allow hot escape, to achieve some ventilation and convection cooling. According to the local Council, the rationale for this system was to keep the carpet clean, which is counterproductive as the carpet and the mosque itself are instituted for worshipper comfort and it is not for building users to suffer in the interests of the carpet. The carpet material is also wool which is warm when praying directly on the floor. The carpets could be kept clean with a different mosque design that is more environmentally friendly and thermally comfortable.



Figure 3. Picture taken in 2004, showing the bad condition of the Big Mosque (left) and the intact but unused Small Mosque (right). Source: Google map

Sometimes the design might create problems, particularly in very hot arid climates, with the large area of the roof of the Large Mosque being exposed to maximum solar heat gain particularly during the summer. This mosque needs to be saved, rehabilitated and protected within its original features. The original characteristics of the Large Mosque may have been irretrievably lost in reconstruction (Figure 4) while the Small Mosque retains some of its original features, which can inform future practices, so that some mistakes in reconstruction or rehabilitation are not repeated again.



Figure 4. Picture taken in 2018, showing the reconstructed Big Mosque (left) and the intact unused Small Mosque (right).

Source: Google map

The following subsections examine these two cases to identify their characteristics in relation to the local socio-cultural, environmental and economic context.

THE SMALL MOSQUE (NORTH-WEST SIDE)

The Small Mosque is situated at the north-west gate of the village, constructed in the late third spatial phase of settlement development in 1950. The total area of the mosque is about (415 m²) and it has three separate spaces, each of which is used at a particular time, exhibiting behavioural adaptations where people move around the mosque to find a suitable indoor environment. The prayer area is separated into two spaces. The front one is opened partly from north side and used in summer called "Almisbah". The rear one is totally closed in the winter time, performing the same functions as Al-Khalwa when used in the winter, but it is above the ground. Both spaces are supported by some circular stone columns. Figure 5 shows the architectural plans of the mosque. Here (M) refers to the front covered prayer space opened from north side "Almisbah", (C) means the open courtyard "Alsarha", (B) indicates the rear covered prayer space, and (S) refers to the storage area.

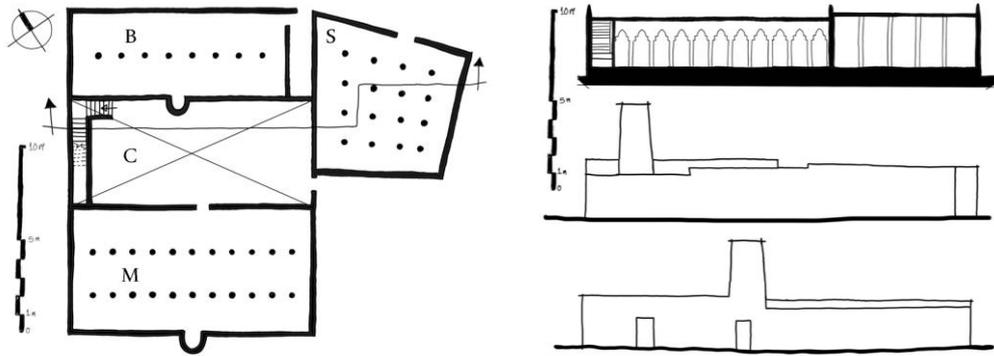


Figure 5. Architectural plans (left) and cross section and elevation (right)

Al-Misbah front space is 3.30 m high, while the rear prayer space is 2.70 m. The mosque has a square minaret, approximately double the height of the Mosque's rectangular prayer hall. It is clear that the front space is higher than the rear, but people moved spaces according to seasonal adaptation strategies. For instance, people used the front covered space in summer, which opens in the north to allow air circulation during the summer time, while they used the lower back space in the winter time to maintain a warm space warm, sheltered from the winds. Al-Sarha, the open courtyard was mostly used in the spring season, whereas "Al-Sath" was used in autumn, as recalled by participants.

The surviving form of this Mosque and its original feature can inform future practices and avoid some mistakes in future reconstruction or rehabilitation projects in contrast to the lost characteristics of the large Mosque. Figure 6 shows some real pictures of the Small Mosque's interior and exterior.

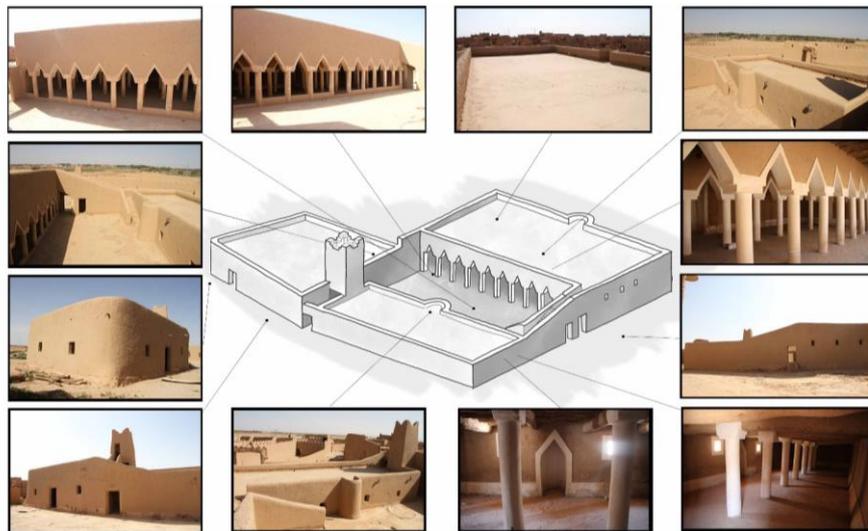


Figure 6. The Small Mosque

THE LARGE FRIDAY MOSQUE (CENTRAL):

The large Mosque is located close to the open central market space in the central part of the village, constructed in 1700 AD. The main prayer hall is supported by circular stone columns using vernacular construction materials. The Mosque is a distinctive local vernacular heritage structure with an exceptional basement that makes the building unique. The total area of the Mosque is approximately (560 m²). It has a tall minaret narrowing upward to a cone with a height of 10, more than double the height of the Mosque's rectangular prayer hall (3.60 m).

Local building materials used in construction include wood and adobe bricks (manufactured using sun-dried mud, water and straw or grass). These distinctive building materials are characteristic of local vernacular techniques, with implications for passive cooling to achieve thermal comfort, as explored by qualitative interviews with local residents.

Figure 7 shows the basic layout of the large Mosque. Here (M) refers to the front covered prayer space "Almisbah", (C) means the open courtyard "Alsarha", (A) indicates the ablution space, (S)

refers to the storage area; (B) indicates the basement “Al-Khalwa” and (E) means outdoor Alesha and indoor women’s prayer space.

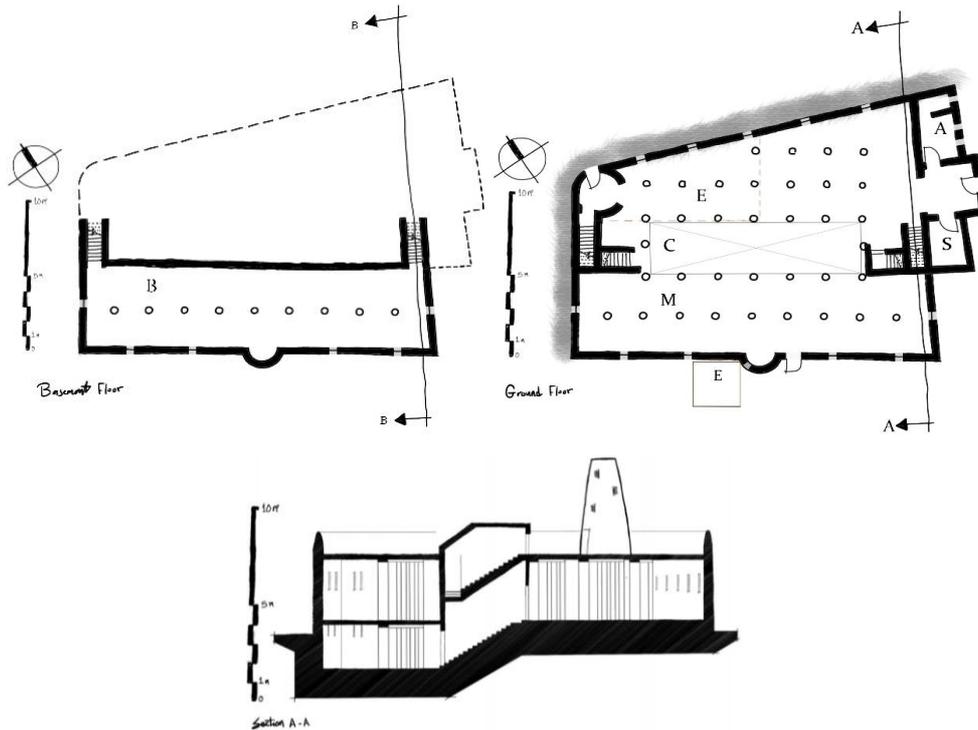


Figure 7. Architectural plans (top) and section (bottom)

The original features of the mosque were lost after the covering of ‘Alsarha’ described previously. The modern retrofitted roof prevents air movement and overheats the space. Figure 8 illustrates the mosque before and after reconstructing, showing a covered courtyard.



Figure 8. ‘‘Alsarha’’ the open courtyard as it was (left), and covered after rehabilitation in 2015 (right)

People retired to Al-Khalwa during extreme heat to enjoy the cool basement space of the large Mosque which is an example of vernacular behavioural adaptations. The architecture and the construction of the basements was important and it was used without any air conditioning into the late 20th century because of its basement passive cooling and heating system (utilizing the underground temperature). In the summer season during peak high temperatures, users went at noon to rest in the Al-Khalwa basement space which remained relatively cold, while it was used at night in the winter due to its relative warmth, as indicated by an interviewee:

“Al-Khalwa was used in extreme hot and cold seasons ” (Ibrahim Al-Omem).

People mostly prayed in the ground floor, but in summer basements were used in the day to avoid the extreme heat, while roofs were used at night. The open courtyard space Alsarha was avoided in summer at noon when the sun was high, but in winter at mid-day people could sit this open ventilated place. In terms of ablution, devotees used to take water from the well next to the mosque and carry it to the “Gero” (stone basin) (Figure 9) in an ablution area as recalled by an interviewee:

“There used to be a garo close to the entrance which was full of water to be used in Wudu (ceremonial washing before prayer) .. water was taken from the well of Jama’at Almasjed (the habitual congregants), surrounded by a fence and there was a tamarisk tree” (Ali Al-Salamh)



Figure 9. Left picture shows the well in circular dots, (right) an example of a stone basin (garo) traditionally used for wudu.

As recalled by an interviewee, the well of Jama'at was located close to the ablution area, as shown in Figure 9, but the local Council removed it from the site as a part of its botched rehabilitation efforts. It should have been preserved, possibly as a working well or at least as an artefact (perhaps with a transparent cover for safety). Perhaps it can be restored as a core part of the heritage of the mosque.

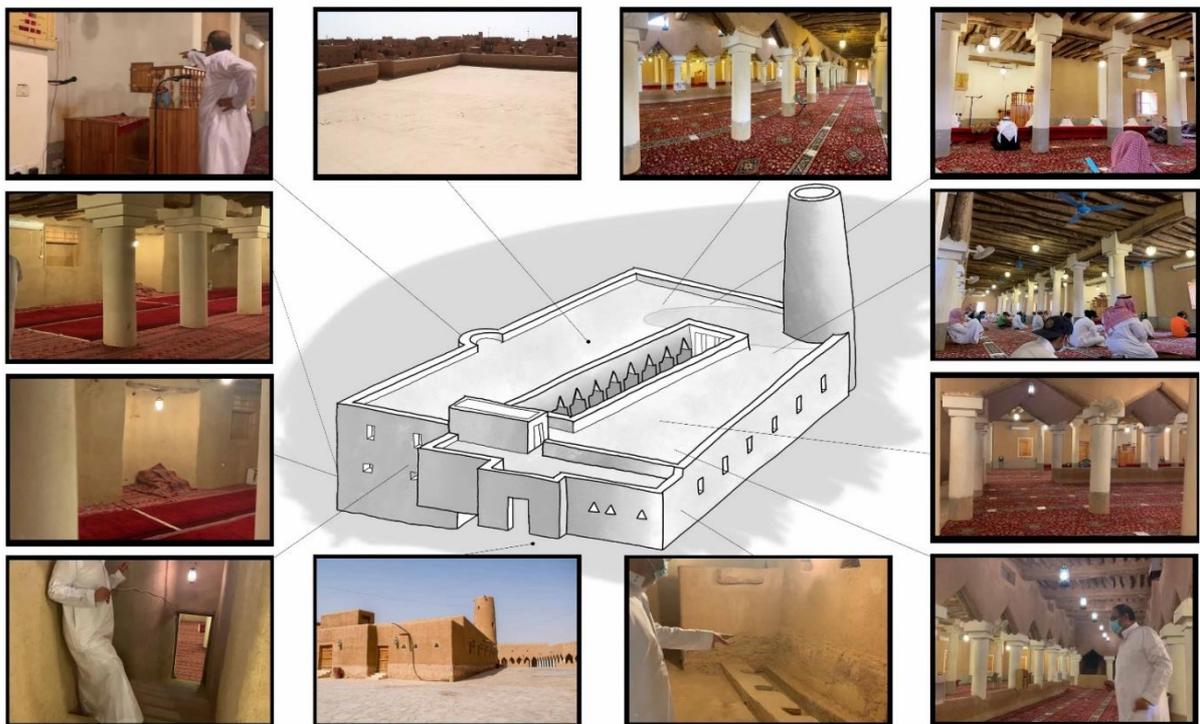


Figure 10. The large Mosque with real images.

COMPARING AL-KHABRA AND OTHER CENTRAL REGION SETTLEMENTS

In general, there is some similarity between the settlements in the Central Region, alongside some differences in urban planning on a large scale or in the design of buildings on a small scale. This section compares Al-Khabra village with some other settlement types of the Central Region.

Four city gates in Al-Khabra lead directly to the large Mosque and central “souq”, where the market was held each Friday (Figure 11). The urban fabric is a distinctive feature with an exceptional circular form, which makes the settlement unique with eight towers distributed around the village as city gates. Other villages have one or multiple gates leading toward the center, as at Al-Diriyh, Ushaiger and Al-Tannomah.

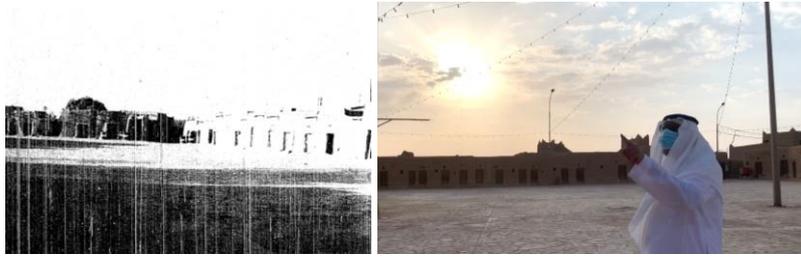


Figure 11. An example of open central ‘‘Souq’’ in Al-Qassim Region (left) Shamekh (1975), and the Souq in 2020 (right).

These mosques have various physical shapes and heights according to the context of achieving privacy and not visually harming the surrounding houses. For example, mosque roofs were similar to the surrounding roofs of dwellings, while minarets were slightly higher. The concept of the minarets enhances differentiation between large mosques which have higher minarets, and the smaller Mosques which have lower minarets (Figure 12).



Figure 12. Al-Khabra small mosque (left) Al-Khabra Friday mosque (right).

However, the mosque spaces in both architectural scales reflect how people dealt with the local climate and their lifestyles, and residents used both the large and small mosques to achieve their requirements. The physical differences between the mosque types were observed in relation to their spaces used and organized (Figure 13).

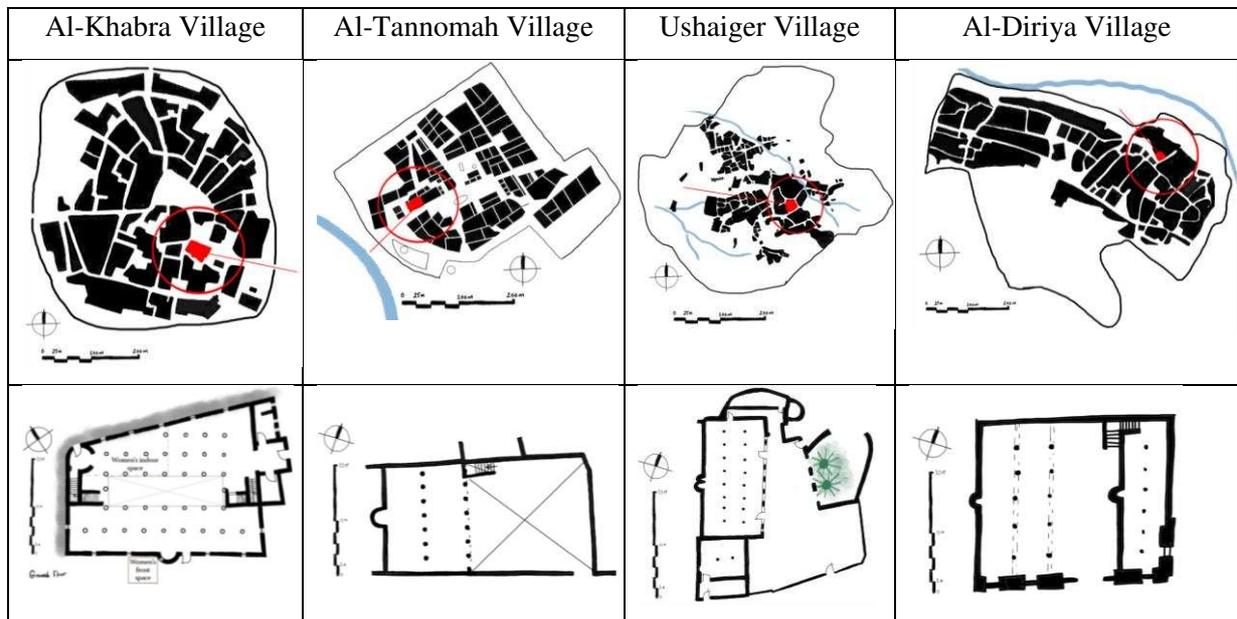


Figure 13. Architectural plans in 4 studied settlements

The small mosques consist of one or two to three closed spaces while the large mosques consist of five distinct spaces (Figure 14), consistently found in the large mosques of Al-Khabra. The large Friday mosques accomplish additional functions such as a community space, a shelter, and a social and cultural hub for the local residents.

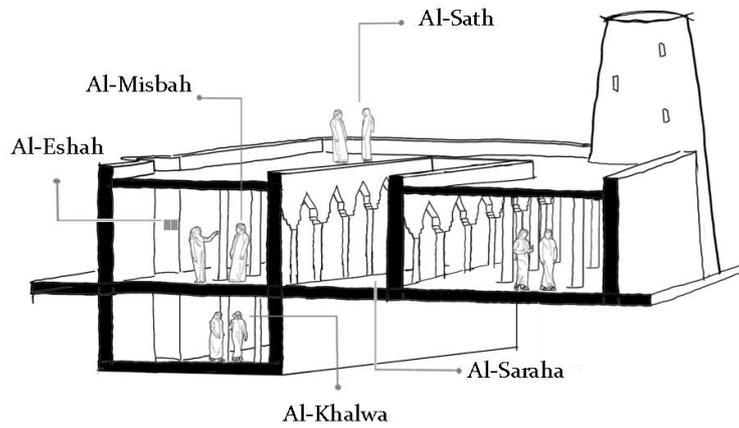


Figure 14. The five components of the large mosque in Al-Khabra

In terms of Al-Eshah (women’s prayer space), there are two spaces; the first space tends to be located at the front of the mosque. During Friday’s prayer, the small window located on the qibla wall next to the “mihrab” (niche in the wall of a mosque indicating the direction of Mecca) is opened so that women can hear the Imam’s preach (see Figure 15). Named Al-Eshah, meaning nest in Arabic. The second indoor space, typically located at the back of the mosque and used temporarily as Ramadan begins, indicates that the number of women worshipers visiting the mosque is rather limited as women tend to pray at home.



Figure 15. Participant pointing out the window left open during the Friday sermon for women

Regarding Al-Khalwa (basement praying space), it is the name given to the basement praying space in the Friday mosque. It is an Arabic word meaning “retreat”. Being an underground space, Al-Khalwa provides a thermally comfortable environment, particularly in the hot summer days and the cold winter nights when temperatures reach extremes.

Vernacular mosques in the Central Region had different usages depending on the climate changes over the year. Local people recalled using the spaces in the large mosques in many ways according to the time of the season, particularly Al-Khalwa being used in extreme winter and summer temperature. This was mentioned by one of the interviewees as follows:

“In the summer, Al-Khalwa is the best place and a very comfortable environment, it is like having an air conditioning, while it becomes warm in extreme winter time.. sometimes we slept in Al-Khalwa during the extreme heat noon time”. (Ali Al-Salamah)

Al-Khalwa is both a social and learning space as well as a thermal comfort spatial adaptation of the mosque architecture. In the extreme of the summer heats, worshippers choose to stay in the cool space of al-Khalwa between afternoon prayers to read the Quran or have a nap. This practice of staying in the mosque to avoid extreme summer heat is found today in the mosque air-conditioned prayer halls during the Hajj and Umrah pilgrimage, when worshippers often choose to stay inside the mosques and even sleep in them between prayers as they are cooler than any other spaces.

Additional cool spaces for summer night praying are also available on the accessible roof of the mosque which is named Al-Sath, meaning the flat roof. Due to generally low yearly rainfall, buildings in the Middle East have flat roofs, which traditionally served multiple functions as a cool praying space in mosques and a cool sleeping space for the houses during the hot summer season.

A modern concrete roof, conversely, serves to radiate heat throughout the night. This was reflected in the following participant's observation:

“In the summer, we sleep in an open place, such as courtyards or roofs ... we do not sleep in rooms at all and its advantage if dawn comes people are awake and we hear the call of prayer, but now the air conditioning is over your head and your feet are numb and there is no one who will wake you up except for the alarm and you wake up lazy this is the differences”. (Abdullah Al-Oremah)

Information gathered from interviewees provides a better understanding of the many ways mosque spaces were used in different seasons and times of the day. The role of the mosque as a community space has been clearly emphasised in the accounts of the previous residents of al Khabra who have been interviewed in this study. They recalled that the village did not have a school until 1950 in the third spatial phase of the village developments and mentioned that the large Friday mosque served as the place of education, with lessons being provided to children between prayer times. Another participant recalled the deeply cohesive nature of the local community who came together in the mosque at prayer times:

“There was someone who looked after people and looked at attendance for those in the mosque who came to pray ... naming worshippers, Ibrahim Saleh, Ali etc ... and people would respond present!” (Ali Al-Salamh)

Another interesting spatial practice revealed by the interviewee is the gathering of worshippers at “Al-Mishraq” means the East. It is a mud bench located at the exterior of the East facing wall of the mosque, allowing men to gather outside to enjoy the sunrise after the al- Fadjr prayer at dawn prayer (Figure 16). Aside from its social role, Al-Mishraq was important in adaptive strategies for the winter, enabling people to enjoy solar warmth in the morning in an open space receiving direct solar exposure often next to or within the Central market (souq). Usually public meetings and appointments would occur there after prayers.



Figure 16. Al-Mishraq with east-facing bench

In addition to its social and environmental role, Al-Mishraq plays an important role for both the physical and psychological wellbeing of the worshippers, allowing daily exposure to early sun rays hence setting the physiological clock and providing vitamin “D” necessary physical and mental wellbeing. The current excessive use of indoor environments that are artificially lit and ventilated has led to the spread of major deficiencies in vitamin D in the contemporary Saudi population as indicated by various studies (see Kaddam et al., 2017). Al-Mishraq was used next to the mosque as illustrated by participants:

“men used to sit outside the mosque after the sunrise prayer, they called it ‘warm Mishraq’ ... Al-Mishraq time is a place where the sunshine shines, until it rises (perpendicular) at noon” (Abdullah Al-Tasan)

It is clear that residents of these vernacular settlements met regularly after prayer, as mentioned by an interviewee:

“we were always seeing each other in the past, helping and standing together as one community” (Abo-Waleed)

The mosque played an important social and was used to meet the diverse need of the local community. The data gathered through interviews indicate that the architecture of Al-Khabra mosques provide a versatile environment that is thermally comfortable at different times of the day and seasons flexible in use allowing many functions to be performed. The large Friday mosques accommodated a larger number of worshippers praying to Allah, but moreover served as an

educational, social and cultural space for the local inhabitants. The mosques are also climatically resilient as they provide an underground gathering space that is comfortable in extreme high or low temperatures. The use of Al-Mishraq as a waiting space between the dawn and the sunrise prayers in the winter, allows for an enjoyable start of the day and exposure to sunlight that is beneficial to the physical and psychological well-being of the worshippers.

CONCLUSION

Mosque architecture is a central element in Muslim communities used to facilitate daily prayers and numerous other functions. With many shapes, styles and characters, the mosque architecture has become a lively and growing research field, but few studies have explored these subjects in the Arabian Peninsula, despite it being the cradle of Islam.

This research has focused on the vernacular architecture of the two mosques in Al-Khabra heritage settlement in Al-Qassim region and analyses their urban role and associated social and cultural practices. It has aimed to explore residents' perceptions, behaviours, and cultural meanings of mosque spaces and investigates the particular characteristics of mosque architecture in Al-Khabra, in comparison with those of other mud vernacular settlements in the same region such as Al-Tannomah, Al-Diriyh and Ushaiger.

A comparative analysis was undertaken to Al-Khabra mosques compared to other settlement mosques in the region, illustrating the specificities of five key components of large vernacular mosques' architecture: Al-Khalwa (basement), Al-Misbah (front covered prayer space), Al-Saraha (open courtyard), Al-Eshah (woman's area), and Al-Sath (roof space). The findings also reveal that people moved around the mosque to find suitable indoor environments in response to temperatures, exhibiting adaptive strategies. Furthermore, mosques served local needs including social, cultural and environmental functions. The mosque is a gathering space in extreme heat; it is a space of resilience where people can go and congregate together in a cool space improvising social life in the basement "Khalwa" instead of staying in very uncomfortable environments on their own. It is a social space that can be a learning space as explored by qualitative interviews with previous local residents. This is a behavioural aspect that has not been considered previously about the role of the mosque as kind of thermal comfort refuge in extreme heat indicating a role in urban resilience.

The paper has also shown that the mosques had various physical shapes and height, achieving privacy and not visually harming the surroundings. The minarets enhanced differentiation between large and small mosques. The large mosques across the settlements were on main arterial roads, close to the central market "Souq", while the small mosques were located in less connected residential areas. Al-Khabra is the only village that had several public streets from the main gates, rendering it unique accessibility features not found in the other studied settlements.

This research can be extended to include the vernacular mosque architecture of the KSA as a whole, taking into consideration the fact that, some of these vernacular mosques have been restored by the "Mohammed bin Salman Project for Historical Mosques Renovation Program" which renovated 30 vernacular mosques out of 130 mosques in 10 different regions of KSA at a cost of \$13.3m.

Future studies can explore newly recognized historic mosques and highlight certain specific elements associated with particular regions, particularly in terms of thermal comfort adaptations and ways in which building users move around mosques to find suitable indoor environment. In addition, the height of minarets should be considered in new mosques. In North Africa, for instance, square minarets had proportional height-width dimensions (the height was five times the width), with municipal authorities having clear regulations about these aspects within regions, but there appears to be no historical knowledge of similar phenomena in Najd and other parts of KSA. Many opportunities have been found to restore Muslim religious heritage and reproduce architectural cultural heritage to connect the past and present, and learn from the former to increase climate resilience and sustainability for future generations.

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