

Vernacular Houses in the United Arab Emirates, Case Study: Sheikh Saeed Al Maktoum House

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Abstract

Vernacular houses are seen across the Middle East - where the high temperature & humidity areas - serve as notable examples of sustainability in architecture. This research aims to interpret the vernacular houses in the United Arab Emirates (UAE) in the city of Dubai in terms of the concepts of sustainability. Focusing on the case study "Sheikh Saeed Al Maktoum House". The house works now as the main tourist destination in the heritage area of Dubai. The research will provide a brief description of the design strategy that focuses on the construction solutions for the temperature, humidity, ventilation, and natural light in order to achieve sustainability. The qualitative research method will be used. The data collected will analysed under two categories: construction techniques and architectural details. The data will be sorted into tables with descriptions & evaluations. The question is: how do the construction techniques and architectural details of vernacular architecture create a sustainable building? How those buildings faced climatic issues in the United Arab Emirates? The research paper provides lessons from local architecture for what contemporary architecture can produce using the case study's analysis (construction material & architecture details).

Keywords: Vernacular Architecture, Climate, Construction Techniques, Architectural Details, UAE

Birleşik Arap Emirlikleri'ndeki Yöresel Konutlar, Örnek Çalışma: Şeyh Saeed Al Maktoum Konutu

Özet

Yüksek sıcaklık ve nem alanlarının daha çok sıklıkla görülebilen orta doğu ülkelerinde, yöresel mimaride dikkate değer sürdürülebilirlik örnekleri olarak hizmet ettiği görülmektedir. Bu araştırma, Birleşik Arap Emirlikleri'nin (BAE) Dubai kentindeki yerel evleri sürdürülebilirlik kavramları açısından yorumlamayı amaçlamaktadır. "Sheikh Saeed Al Maktoum House" vaka çalışmasına odaklanarak. Ev, şu anda Dubai'nin miras alanındaki ana turistik yer olarak hizmet vermektedir. Bu çalışma, tamamen Sıcaklık\Nem, Havalandırma ve Doğal Işık konularında inşaat çözümlerini uygulayarak sürdürülebilirliği sağlamaya dayalı tasarım yaklaşımını kısaca tanıttacaktır. Bu çalışmada, nitel araştırma yöntemi kullanılacaktır. Toplanan veriler, İnşaat Teknikleri ve Mimari Detaylar olmak üzere iki kategori altında analiz edilecektir. Veriler, açıklama ve değerlendirme ile tablolar halinde sıralanacaktır. Soru şu: yöresel mimarinin Yapım Teknikleri ve Mimari Detayları nasıl sürdürülebilir bir bina yaratır? Bu binalar Birleşik Arap Emirlikleri'ndeki iklim sorunları ile nasıl karşılaştı? Araştırma makalesi, vaka çalışmasının analizini (inşaat malzemesi ve mimari detayları) kullanarak çağdaş mimarinin neler üretebileceği konusunda yerel mimariden dersler sunacaktır.

Anahtar Kelimeler: Yöresel mimari, İklim, Yapım Teknikleri, Mimari Detaylar, Birleşik Arab Emirlikleri.

1. INTRODUCTION

1.1. Problem Statement

The United Arab Emirates (UAE) is a rapidly growing country. The UAE is classified among the categories of countries with the highest rate of impact of climate change in the world with temperatures reaching 55 degrees in the summer. Construction techniques and architectural details improved throughout the development of the residential buildings. Unfortunately, the current way to offer thermal comfort is air conditioning. In this way, they consumed a huge amount of electricity and natural resources depending on non-renewable resources. Therefore,

this study is going back into the time to the 19th century for learning lessons from the notable vernacular house: Sheikh Saeed Al Maktoum house. Hawker, a researcher in the department of Art and Design, Zayed University, Dubai has noticed that: the indoor air quality (IAQ) - in the selected case study - along with the natural light has been solved with some traditional techniques without causing a negative impact on the surrounded environment (Hawker, 2002). This research paper will focus on analysing how the problem was solved in a designed manner- construction techniques and architectural details.

1.2. Aims and Objectives of Study

The Sheikh Saeed House in Dubai's "Shindig District" is one of the most important buildings from the 19th century period as a representation of vernacular architecture in the country (Hawker, 2002). The aim of this study is to highlight the vernacular architectural elements and explore lessons of sustainability. By considering the specific architectural methods characterizing the architectural appearance of the Sheikh Saeed Al Maktoum house. Thus, we can see how the house supported its users and offered them suitable conditions. This paper will highlight the construction methods along with architectural details of a vernacular house in the UAE. Exploring the advantages of the vernacular architecture features. The research will try to answer the questions: How do the construction techniques and architectural details of vernacular architecture create a sustainable building? How those buildings faced climatic issues in the UAE?

1.3. Research Methodology

The study utilizes qualitative methods. The qualitative methods are a literature review and pictures/drawings analysis. Data is collected through a literature review. The main tactic is analysing the drawings and pictures of Sheikh Saeed house from the perspective of construction techniques and architecture details. The method of sorting the information is using inventory tables for the case study. The techniques of analysis of the drawings were done by using AutoCAD & Photoshop software.

2. LITERATURE REVIEW

2.1 Vernacular Architecture

Vernacular implies 'domestic, native, indigenous and comes from the Latin phrase '*Verna*' which means '*native slave*' or '*home-born slave*'. The phrase vernacular comes from linguistics, where it relates to language usage specific to a time, region, or community (Etymonline, 2018). The traditional scientific term is the "native," which refers to a person's connection with the land where they belong (Ganju, 2016). The alternatives for this phrase are numerous; anonymous, popular, indigenous, primitive, spontaneous, every day, and shared are among them (Lawrence, 2013). The term traditional can be a definition for vernacular as it is referring to both practices and tangible items that have long been accepted as standard in a society and whose components are passed down from one generation to the next (Noble, 2014). Vernacular architecture refers to architectural techniques that use locally accessible resources and customs to meet local demands (Fernandes et al., 2014). Moreover, vernacular architecture is a style of building created without the aid of a trained architect using readily available local resources. Since earlier times, adjustments have been made to these structures to better fit their surroundings. Local climate is in harmony with vernacular structures. Due to the fact that they are constructed from eco-friendly materials (Camilla, 2005).

The writer of the book “*Vernacular Building*” explained the what happen in traditional societies in traditional communities improvise and use what is available to them. The availability of local materials, the characteristics of the local climate, and socioeconomic realities, for instance, place restrictions on the shape and arrangement of residences. Everything in a living space serves a purpose, and its aesthetic qualities emerge subtly from the serious of living (Noble, 2014).

The significance of vernacular architecture carries the advantage of local expertise and norms for the design of the building. Using local materials and resources, which means they're generally energy-efficient and long-lasting. They are frequently created with the local climatic conditions in account and work effectively. Moreover, presenting an essential link between individuals and their surroundings (URL-1).

2.2 Vernacular Architecture in the United Arab Emirates

The vernacular architecture in the United Arab Emirates results from the interaction of recurring elements including the environment (temperature, construction materials, soils, and geography), culture (religious ideology, beliefs, norms, and ritual), and acquired knowledge (Alkhalidi, 2013). The following discussion is about the primary influences that have revealed the vernacular architecture in the Gulf region, particularly in the United Arab Emirates.

- **Religion & Social Factor**

Islam's influence is readily visible in vernacular architecture due to its emphasis on social justice. All of the community's homes were treated equally in terms of exterior treatment, building materials, and construction techniques. Additionally, the majority of the community's members took part in the construction of each house. Regarding exterior design, construction materials, and building techniques, all of the neighbourhood's houses were handled identically. The bulk of the society members also contributed to the building of each dwelling. Religion forbids the use of any ornaments or paintings that depict any being that has a spirit. This is the rationale behind the use of simple geometric shapes, calligraphy, and plant as decorative elements in dwellings. When they reach puberty, siblings of both genders must be separated. Each has his/her own private separate bedroom. Because of the privacy concept builders created the division between the interior and exterior parts of the buildings (Hakim, 2013).

- **The Climate Factor**

The second factor is the climate which has a direct impact on the architecture. The harsh weather conditions forced the builders to create solutions, one of the famous solution features in vernacular architecture in UAE was the (wind towers).

In UAE there are only two main seasons: winter and summer, which are separated by two transitional months, respectively. The country has an arid desert climate with high temperatures and humidity. The climate context for the United Arab Emirates for the climatology that is currently in effect for the years 1991 to 2020 shows that August is the hottest month, with an average extreme heat of almost 42°C and average minimum readings of 30°C. The minimum temperature is at the beginning of the year reaching a degree between 10°C to 15°C. The possibility of precipitation during the whole period reached the maxim of 17 mm (Figure 1) (CRU, 2022).

Monthly Climatology of Min-Temperature, Mean-Temperature, Max-Temperature & Precipitation 1991-2020
United Arab Emirates

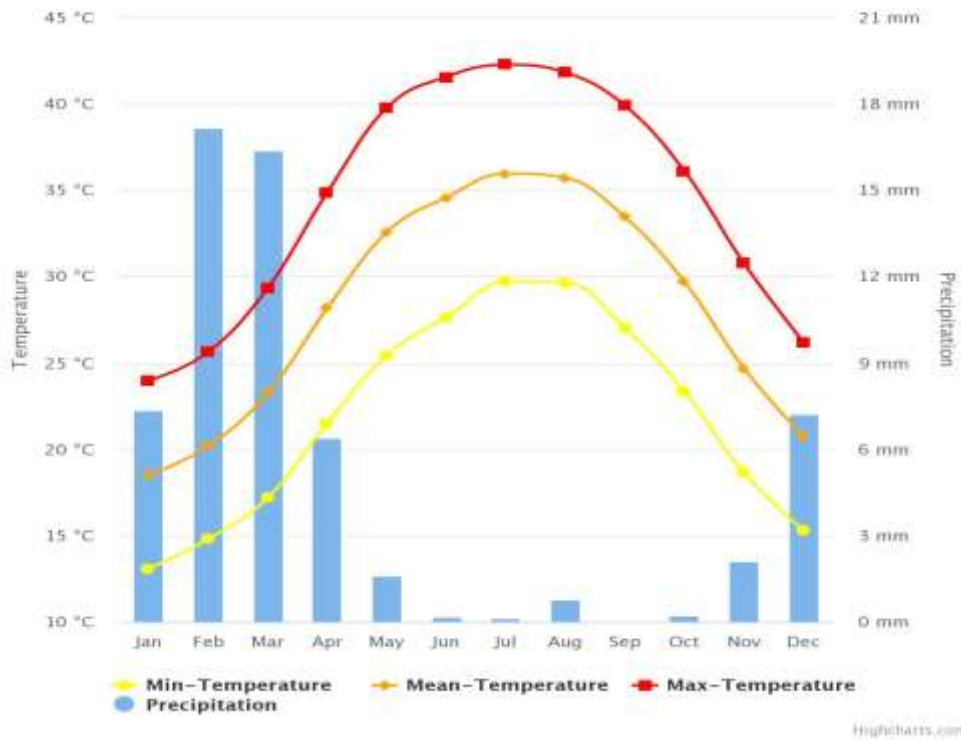


Figure 1: UAE climate graph period of 1991 – 2020 (CRU, 2022).

- **Wind Towers**

Wind towers have been used as architectural elements for achieving thermal comfort within buildings throughout history in the Gulf Area. The *wind tower* is called in the local language Al-Barajeel (Figure 2) (Assi, 2022).

The Al-Barajeel is a type of design that is enclosed to allow air into the structure and is open on all four sides to catch the breezes coming from all directions. It is described as a tall rectangular tower with four columns, it converts hot air rising from the port into the cold air, acting as an "architectural fan" or air conditioner to counteract the severe climate and high summer temperatures. It achieves climatic balance by altering the direction of the wind vertically inward, giving it an art form and richness. Before the invention of modern air conditioners, AL-Barjeel was a means of coping with the challenging weather and high temperatures (Figure 3) (Tony, 2022).



Figure 2: Al- Barajeel as appear at the roof of the buildings (Alkhalidi, 2013).

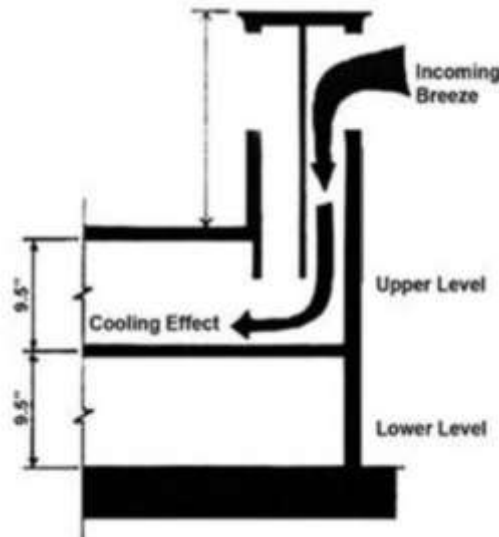


Figure 3: Cross section for wind tower (Alkhalidi, 2013).

- **Architecture Details & Construction Material**

This paper specifically discusses permanent dwelling in the United Arab Emirates. The vernacular building was built with in-place developed indigenous materials such as clay, limestone, coral, stone, and wood (Alrashed, 2017).

The space was designed around a main courtyard. In traditional homes, the courtyard design was used to achieve the desired privacy, natural ventilation, and lighting (Ragette, 2006). According to the local customs of gender segregation interior spaces was designed and separated. The apertures were used as arches, windows, doorways, and decorative elements in the style of *Al Masrabiya* (Figure 4). Walls were heavily emphasized as segregation, environmental, and structural elements (Joseph, 2017). The thickness of the walls ranges from 35 to 80 cm, while the thickness of the roof is between 30 and 65 cm, depending on the size of the home and the number of levels (Ragette, 2006).



Figure 4: Al Masrabiya window design (URL-2)

2.3 Air Indoor Quality

Indoor air quality (IAQ) is considered by the Environmental Protection Agency (EPA) as "the air quality within and around buildings and structures, especially as it relates to the health and comfort of building occupants" (EPA). This paper will focus on the ventilation, high temperature \ humidity & natural light

- **Ventilation**

The ventilation system in vernacular architecture depend on the natural ventilation. Which is a type of cooling, that has the ability to cool the body instantly through circulation and evaporation, or indirectly by cooling the structure of the building surrounding the inhabitants. The sort of cooling method to use is determined by the climate, the type of building, and the intended indoor thermal (B. H., 2020).

Natural ventilation is having various advantages. Firstly, the efficient in terms of energy. buildings that are naturally ventilated consume much less energy than those that are mechanically ventilated and climate controlled. The quality of the indoor surroundings has increased. The capacity to modify their local environment in a building by opening windows is something that many inhabit seek. Moreover, the health advantages of the natural ventilation aids in the maintenance of a healthy lifestyle. The air in the fresh air, for example, can improve heart rate, blood pressure, and energy levels. It boosts the immune system's defences. Because of the greater serotonin levels, it also helps the occupants feel rested and rejuvenated. Capital, maintenance, and replacement costs are all minimized (B. H., 2020).

- **High Temperature & Humidity**

The arid desert climate in UAE is characterized by high temperatures and humidity. In vernacular architecture, there are different variables of building elements (roofs, walls, doors/windows, floors, and ornaments) that respond to climate conditions both in form and function. The traditional architecture of the gulf's cities and villages succeeded to maximize shade, lessen solar radiation's thermal gain, controlling building temperature, and improving airflow. That was a result of a creative combination of building materials, positioning, and design.

Humidity and high temperatures were controlled by the use of natural building materials. Mud and Limestone substances can absorb moisture in damp environments, which can later evaporate on hot, sunny days to produce a very mild cooling effect. Additionally, the structures' sandy hue and texture limit the absorption as well as the release of heat (Erwin, 2015).

- **Natural Light**

In vernacular architecture, natural lighting is the main source of light that is available and largely achieved through architectural elements (Michael, 2017). Natural light, often known as daylighting, is a technique that uses outside linking methods (windows, skylights, courtyard, etc.) to efficiently bring natural light into interior spaces, decreasing artificial proper lighting and conserving energy.

Natural illumination has been shown to improve building inhabitants' health and comfort. Moreover, it has a significant impact on human comfort, health, and mood, yet it differs based on our location. It is essential to the design of a building in construction, and it adds value (URL-3).

3. CASE STUDY

3.1 Sheikh Saeed Al Maktoum House

According to Dubai Culture Government (2018) The Sheikh Saeed Al Maktoum house is a historical museum that once served as the residence of Saeed bin Maktoum. Al Maktoum, the former ruler of Dubai in the United Arab Emirates. The structure is situated along Dubai Creek in the *Al Shindagha* neighbourhood. It was founded in 1896 as the family seat of the Al Maktoum family. The building has a total size of 3,600 square meters. The structure is now used as a museum with items and photos of Dubai's old town. The museum contains nine wings; the heritage of Saeed Al Maktoum house, Al Maktoum family, old Dubai, marine life, views from Dubai, social life in Dubai, coins and stamps, historic records, and maps (Figure 5 & Figure 6).



Figure 5: Dubai location on map (URL-4)



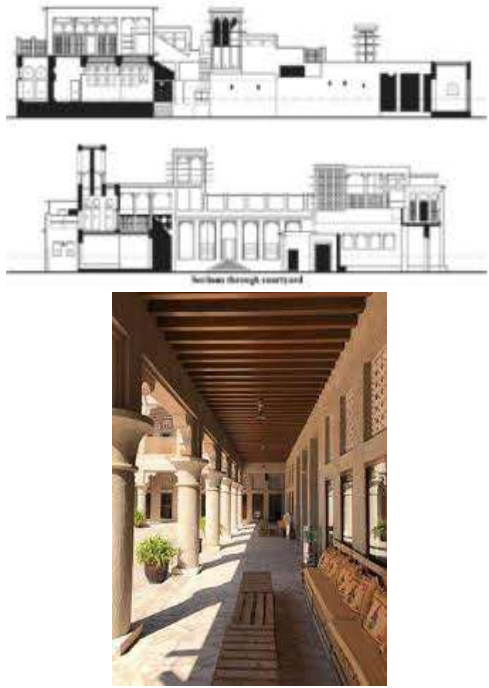
Figure 6: Exterior view for Sheikh Saeed Al Maktoum house (URL-5)

3.2 Construction Techniques

In this table the Sheikh Saeed Al Maktoum house will be analysed through the preceptive of construction techniques and evaluated (Table 1).

Table1: The evaluation of the construction techniques in the Sheikh Saeed Al Maktoum house


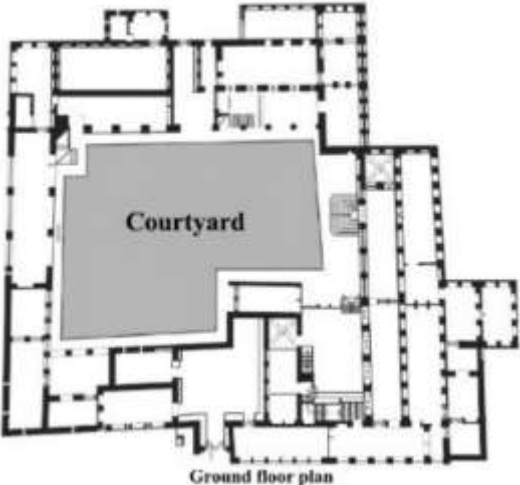
Techniques	Picture /Layout	Descriptions & Evaluations
Walling Materials & Construction Methods	<p>Traditional coral stone</p> <p>Traditinal wooden ceiling</p> <p>Coral stone wall</p>	<p>Description: The material as seen; palm trunks, coral shells, sea stone wooden joists & woven mats. A combination of clay, sands, gypsum, and limestone also served as the wall's substance. The wall's thickness range from interior to exterior from 0.5 m to 1.6 m (Hawker, 2008).</p> <p>Evaluation: The material was from the local environment (Greek side) seaside. The thickness of the wall and the material work together to create a sturdy, solid building with a large thermodynamic efficiency.</p>



<p>Roofing Shape</p>	 <p>The image contains three architectural representations of the roof structure. At the top is a cross-section showing multiple levels and a prominent wind tower. Below it is another cross-section, labeled 'Section through courtyard', showing a different part of the building with a central courtyard. At the bottom is a photograph of a long, covered walkway with a wooden ceiling and stone columns, illustrating the interior roof structure.</p>	<p>Description: The roof as seen in the sections show various level. Wind towers as the highest in the sections. The building does not act like one solid cubism. The interior roof shape is straight with some decorations.</p> <p>Evaluation: The difference in Height creates a good method for ventilation & natural light. Wind-Towers are the main features which enhance the IQA. The interior roof shape creates shadow and decreases the temperatures.</p>
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3.3 Architectural Details

In the table below the Sheikh Saeed Al Maktoum house will be analysed through the preceptive of architectural details and evaluated (Table 2)

Table2: The evaluation of the architectural details in the Sheikh Saeed Al Maktoum house

Architectural Details	Picture/ layout	Descriptions & Evaluations
Windows & Openings		<p>Description: The house has many kinds of openings; Arches, Open windows (without material only some fabrics), Opening works as doors–arches-(without material) & an architectural feature known as <i>Al-Mashrabiya</i> (glass door screening) conceals openings on upper levels that face out onto the external or internal of the house's court.</p> <p>Evaluation: The arches create an aesthetic Islamic effect from the local culture, the opening window has the role of natural light access and wind access. In consideration of the arid climate of the areas where it evolved, <i>Mashrabiya</i> was designed to meet a variety of functions besides its artistic value and social implications. These functions include making a personal space, managing the passing of natural daylight to preserve inhabitants from the scorching sun, and regulating the local climate by adjusting airflow, reducing the temperature of wind currents, and raising the humidity, along with many other things, in the dwelling. Due to the air circulation they produce, all opening components work together with the court and breezes to provide a cooling system.</p>
Courtyard	 <p style="text-align: center;">Ground floor plan</p>	<p>Description: The courtyard works as a semi-private area in the middle of the house and provides a link between the inner rooms. In the UAE, traditional homes often have a courtyard layout with rectangular areas (the standard area of a large room is 3 by 8 m). (Al-Sallal, 2018) The courtyard walls are made of stones or bricks of appropriate thickness. Such sidewalls have windows and openings, particularly these facing the road and pointing toward the interior courtyard.</p> <p>Evaluation: In UAE which has a hot, arid area, the courtyard takes advantage of its vast surface space and heating capacity to retain the heat during the day, providing comfort on chilly nights. The yard acts as a heat sink by maximizing the surface-to-volume ratio, limiting extreme temperature stresses, and reducing an</p>

		<p>acceptable level of interior heat into the night air. In a context where a building's architecture and environmental performance complement one another, courtyards are vital in cooling buildings by creating a climate between both the internal and outdoor surroundings that is calm & cleaner.</p>
<p>The Wind Towers</p>		<p>Description: The house contains four wind towers, which are traditional towers that are created and installed on the building's top. <i>Areesh</i> palm trunks and leaves were used to construct the tower, but the coral was subsequently used. The typical wind towers have vents, a rooftop, a head, a canal, and interior walls.</p> <p>Evaluation: The house conditioning and venting are assisted by wind towers, and the thermal comfort for inhabitants provide in a natural way and energy-free. Heated air (less dense) rises to the top of a wind tower and escapes through the ventilation routes, colder breezes enter the house to replace the lost air as they descend. On the concept of pressure ratio, wind turbines operate. That change throughout the day. The flow of exterior breezes at the roof level produces positive pressure on the windward side and negative pressure on the leeward side in the mornings. This brings fresh air into the room while removing stale and heated air.</p>

3.4 Findings & Result

The research offers a comprehensive look at a resident example in the Gulf area. The study concern about the sustainability of vernacular settings where the knowledge of vernacular building techniques. These techniques can be reused for serval solutions for future architecture forms. The various elements within the two major concerns in this paper (construction techniques & architectural details) of Sheikh Saeed Al Maktoum house in the UAE appeared as a design solution to withstand the harsh climate of the Gulf area. The design also works to preserve the traditional cultural expectations and local socio-economic. Starting from the natural material & roof shaping were construction techniques that demonstrated how the vernacular house was created. The local material (seaside materials) and the various levels of the roof shape offered thermal comfort for the resident. In terms of ventilation the paper results that the wind-towers were the main feature for enhancing indoor air quality on hot days, however, the courtyard works also in the same manner but mostly in the winter season. Along with the exterior wall thickness which reached 1.6 meters. All together create a comfortable thermal for the interior spaces (Figure 7).

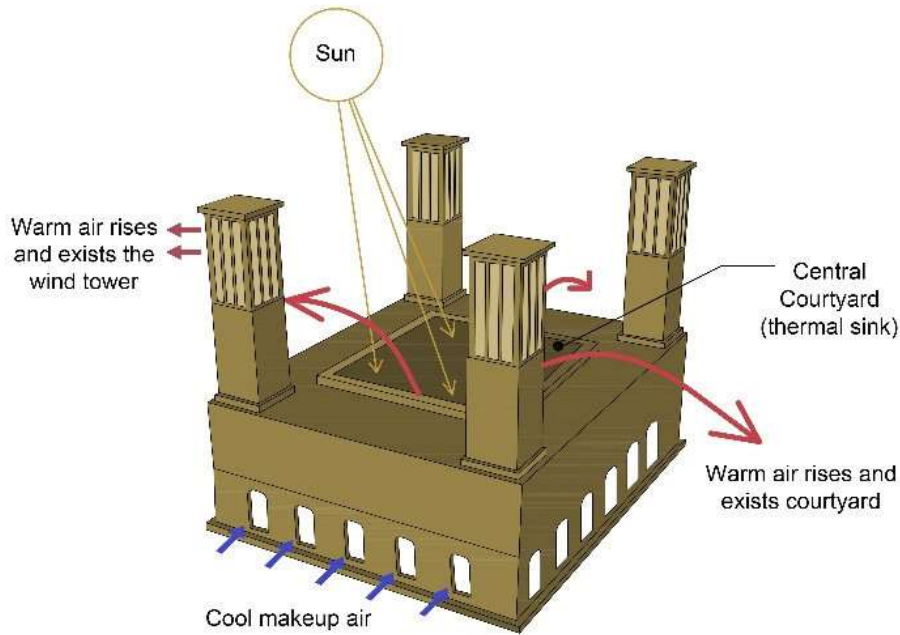


Figure 7: Air circulation using the courtyard & wind towers (URL - 6)

The architectural details for the house include; opening/windows, courtyard & wind-towers. The house contains various options for “opening” each one has a role in natural lighting and ventilation for example: *Al Mashirbyia* an element offered by the local design & material has the role of natural lighting along with ventilation. Arches surrounded the inner courtyard creating inner aisles. These details have an aesthetic Islamic effect from the local culture. In the United Arab Emirates, vernacular design can be used to create an effective contemporary sustainable solution that stresses localism and is influenced by the vocabulary of the sense of place. Architect has to reconsider vernacular sustainable solutions by evaluating their methods against their initial design goals while following sustainable development guidelines. Moreover, the case study can be introduced as an effective type of "Cultural Heritage" based on the analysis of architectural features, and historic, cultural, and environmental significance.

4. CONCLUSION & RECOMMENDATION

Architecture nowadays seems to have mostly forgotten about vernacular architecture settings, which is a very adaptable and sensible manner to meet human requirements. Architects are embracing regionalism and the heritage shown in the historic buildings, claiming that these buildings have been shown to be extremely sustainable and energy-efficient. There is still much to be learned from the cumulative wisdom inherent in ancient architecture in the age of fast technological advancement and vast construction. The vernacular architecture employs low-tech techniques that can be utilized to design structures and settings that are compatible with the local climate and culture. This is in sustainable features of vernacular architecture in contrast to the design of many modern buildings that do not take local conditions into account.

This study highlighted Dubai, the most rapidly growing city by analysing one of the resident heritage buildings. Nevertheless, this research needs to be expanded more about the urbans. In terms of building orientation towards sunlight & breeze.

The study has ended with recommendation:

-The contemporary trend in the city has to be changed rationally in another direction as a result of the mounting pressure from current global environmental challenges.

- Instead of being rigidly copied, heritage buildings should be examined so that their teachings and design features can be applied to modern construction techniques.
- Three models can be reused to enhance the ventilation process, from the study: wind-towers, Al Mashrabiya & courtyard.
- The aesthetic Islamic effect from the local culture can be presented as decoration features of vernacular architecture example of; AL-Mashrabiya
- The Natural light tools; opening, courtyard, and roof shaping can be efficient for sustainable reasons & release the pressure on consuming a huge amount of electricity depending on non-renewable resources.
- For facing the harsh climate, the thicknesses of the exterior walls and the use of natural material can work together to create a sturdy, solid building with a large thermodynamic efficiency.

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