

# Integration of the Vernacular Passive Cooling Systems with Contemporary Architecture in the Middle East

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**Abstract:** Vernacular architecture has always served the people of a certain climatic condition with the required answers to their immediate environmental problems. The architecture without architects has been a major focus of late as architects tend to reflect back to how their ancestors tackled the problem of the environment when it came to buildings and design. Human need, cultural identity as well as the surrounding context has been a pivotal focus for vernacular architecture. The Middle East as a region is a land with diverse cultures that have been united by the climatic conditions of their land which is hot and dry for the most part of it. To tackle the heat and the direct harsh sun of the Middle east, certain techniques and elements were devised to combat them. Such devices like the Mashrabiya, Wind Catchers and Courtyards were used, among others. The 21st Century urbanization and rapid universality of contemporary architecture combined with the oil and gas industry wealth of the Middle East has made this region join the in the mad rush to compete in the frontlines of rapid urbanization and somehow neglect their vernacular architecture and cultural identities in place of the more lucrative contemporary architecture. This study focuses on finding a common ground for vernacular architecture and the 21st-century contemporary architecture without compromising each other. The study will look at Mashrabiya and Windcatchers, elements of the Middle Eastern vernacular architecture and a case study which is a pioneer in the use of vernacular elements in the 21st-century contemporary architecture. The study seeks to find better options when designing a building in the Middle East with consideration of the vernacular aspect of the region achieved by literature reviews of journals, articles, and theses.

**Keywords:** Contemporary Architecture, Middle East, Passive and cooling systems, Vernacular Architecture.

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## 1. INTRODUCTION

In our current age, architects and designers alike are consumed by the idea of the 21st-century contemporary aesthetic and architecture and face a challenge of addressing the problem of environment. Vernacular architecture has been a key player in terms of addressing the issues of environmental concern and context. This architecture has been labeled outdated or primitive therefore a question arises, is vernacular and contemporary architecture compatible at our current time and age? Some argue that vernacular architecture is different compared to contemporary architecture while others conclude that contemporary architecture can be a continuation of vernacular architecture. Therefore, can a modern contemporary building have vernacular aspects and elements added to it to improve its sustainability and climatic adaptation? During the 20th century, the interest in urban and architectural heritage was focused just on their valuation as cultural legacy and its conservation. In the 21st century emerges a new landmark of interest: recovery of ancestral knowledge embodied in designs, which do not need equipment or technology to enjoy comfortable temperatures, and therefore, they were sustainable. [1]

This study primarily focuses on finding ways to integrate passive and cooling vernacular elements into our 21st-century contemporary architecture so that it can be considered sustainable and fit right into its climatic environment in the Middle East. The study will focus on vernacular systems of passive cooling in the Middle East and by reviewing a case study with several other pieces of literature. The introduction of these vernacular passive cooling systems to our contemporary architecture in a proper manner can be a useful instrument for thermal comfort for buildings especially in the Middle Eastern region and a pride and reminder of their heritage and rich culture. The major advantage of these vernacular passive cooling systems is that it requires little to no energy for their operation. Other advantages include revival and preservation of the regional cultural legacy and little to no greenhouse gas emissions thus a good combatant of climate change.

#### **Problem Statement:**

The 21<sup>st</sup> Century urbanization and universality of contemporary architecture combined with the oil and gas industry wealth of the Middle East has made this region join in the mad rush to compete in the frontlines of urban development and somehow neglect their vernacular architecture and cultural identities in place of the more lucrative contemporary architecture.

#### **Aim of the Study:**

The research aims to compare the vernacular and the modern-day architecture in the Middle East. By integrating the vernacular architecture into our contemporary and modern buildings, the research also aims to determine whether a hybrid building consisting of vernacular and modern aspects can stand the test of sustainability and comfort levels especially for the dwellers of the uncomfortable desert life of the middle eastern desert.

## **2. VERNACULAR ARCHITECTURE**

Vernacular architecture characterizes houses made from locally available materials, shaped by local climate and reflects the regional culture and traditions. It serves as a mirror of society and needs of human beings at a certain time. Vernacular buildings represent ingenious and considerable technical innovations and perform spectacular handicraft work. The construction techniques and forms were evolving over hundred years by generations to meet their every day's needs.

This discipline of primitive architecture can be named as Bernard Rudofsky did in his book, *Architecture Without Architects* [2]. The concept of this architecture includes venerable, anonymous and indigenous architecture. It is so little known and little discussed so that we do not even have an exact name for it (Rudofsky, 1964) [2].

With the words of Amos Rapaport, we can describe vernacular architecture as lack of theoretical or aesthetic pretensions, working with the site and micro-climate, respect for the other people and their houses and hence for the total environment, man-made as well as natural and working within an idiom with variations within a given order [3].

## **3. CONTEMPORARY ARCHITECTURE**

The world of architecture and the building industry has a significant impact on the environment, surrounding and primarily to our lives. To characterize contemporary architecture and the modern society, we will for sure use the keywords now, today and current. Every single day we reveal new techniques and methods on how to improve our architectural masterpieces. The exuberant sculptures of a Frank Gehry or Zaha Hadid prove us the power of intellect, but mainly the power and dominance over nature.

The main problem of contemporary or modern architecture " is not lack of freedom, but freedom itself. Traditional and architectural typology turns into out-of-date", as stated by Oldřich Ševčík in architectural scripts [4].

Is this modern society really producing a mainstream architectural style? What does the word architecture really mean to us? Are we aware of the impact of our buildings and architecture? Do we have any respect or are we just proving our power over nature? Do we really want to create the buildings just for 20-50 years? All of these questions can be answered in a wide range of essays and books, but it is important to keep them in the mind a bit when reading this study because exactly these questions led me to write about this topic.

#### 4. PASSIVE COOLING SYSTEMS USED IN THE MIDDLE EASTERN VERNACULAR ARCHITECTURE

##### 4.1. Wind towers:

A wind tower, sometimes referred to as 'wind catcher' captures the hot summer winds and cools it down and circulates it through the building. A tower rises from above the roof and ends in the basement (Fig 1).

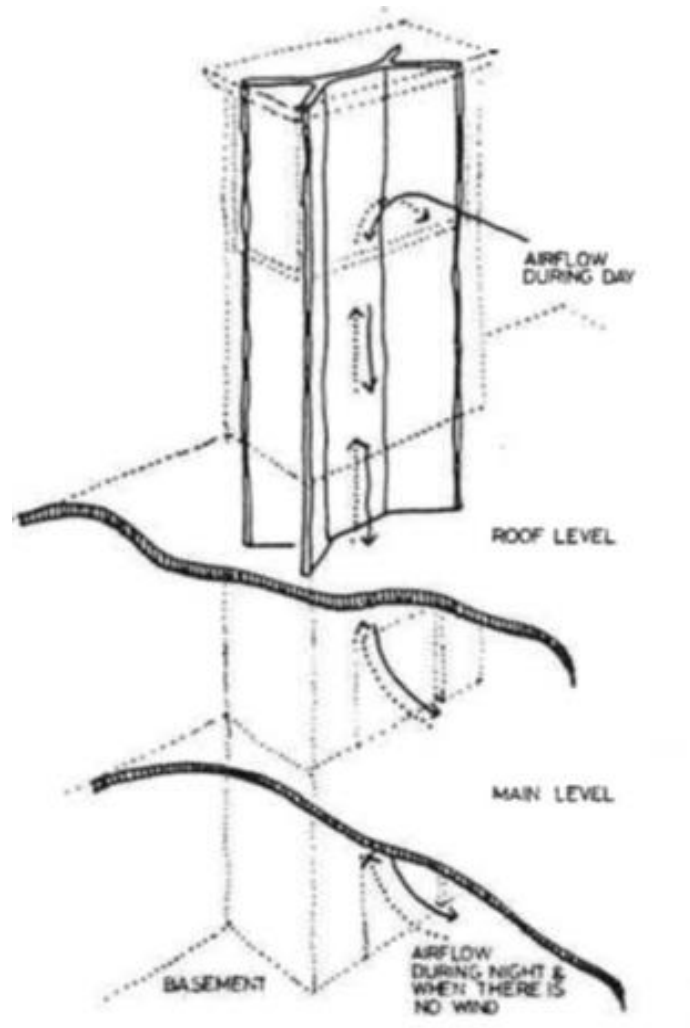


Fig 1: Ventilation of a wind tower. [5]

A wind tower works by varying the temperature using the air density in and around the tower. The tower ends in the basement and to the main level of the structure. The flow of the air is manipulated by opening or shutting the air access panels in the tower and the doors of the rooms off the central space where the tower opens normally on the main level of the structure [5].

##### 4.2. Mashrabiya:

Another system of this vernacular architecture is the mashrabiyya. Mashrabiya is a shading appliance or extension made from wooden lattice. Originally the primary use was to store jars of water, so the name means "drink" in Arabic. This feature helps to control the climate and temperature inside the house, supply of light, regulate air flow and increase humidity.

Because mashrabiya are made of wood, it helps to create a comfort microclimate. The wood absorbs, retains and releases water from jars and the air passes through the porous lattices which in turn vaporizes some of the moisture gathered on the wood (Fig 2 and 3).

An important effect is how mashrabiya work with light penetration. By Nisrine Naciri paraphrasing the architect Hassan Fathy, the south sunlight entering a room has two components: the direct high-intensity sunlight and the lower intensity reflected glare, the mashrabiya interstices both intercept the direct solar radiation and soften the uncomfortable glare. [6]



Fig 2: Mashrabiya. [7]

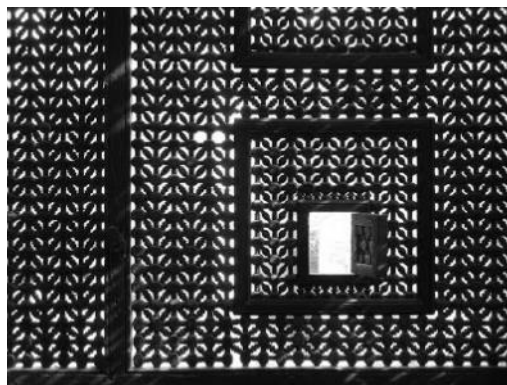


Fig 3: The ornamental grid which allow the air to ventilate, but shade in the same moment [7]

## 5. CONTEMPORARY TRENDS OF USING VERNACULAR ARCHITECTURE IN MIDDLE EASTERN ARCHITECTURE

Contemporary architectural trends incorporating vernacular techniques and systems into the new buildings being built in the middle east have been developing all around the region. These trends follow different principles and blueprints in implementing the merging of these two architectural styles. A reason for this new trends of integration is the search of identity and a realization of the importance of these vernacular systems and how they work best for the climate of the region in opposition to new glass, steel and concrete way of building. In this study, we will focus on the neo-traditional trend and the contemporary interpretation trend. [8]

### 5.1. Neo traditional trend:

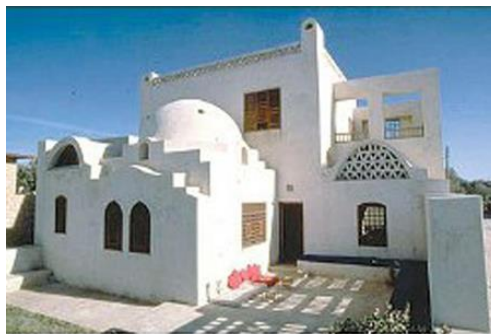
“Authenticity in architecture means investigating and studying the architectural values of the past and then take advantage of their lessons without copying the models” [9]. Hamuda rallies architects to learn from the past instead of emulating it completely. Two approaches to this trend are visible, the first being a full incorporation of vernacular features without changing anything while the other is experimenting with the past to learn from it and gaining an insight of it [8]. Abdelwahel Alwakeel is aligned to the first approach while Hassan Fathy is a pioneer of the latter.

Many architects following this trend believe that they are mainly addressing the issue of cultural loss of identity. Hassan Fathy, a pioneer encouraged many Middle Eastern architects to follow this trend. Although their interpretations of the trend were different compared to the original interpretation by Fathy, but the main principle was fixed, which is taking the

lessons from experiments of the past [8]. It is important to denote that Fathy adopted this approach to express the community rather than creating a trend for its own sake. He claims “there must be neither fake tradition nor faked modernity, but an architecture that will be the visible and permanent expression of the community” [10].

### 5.1.1 Features of this trend:

Domes & vaults is an important feature of this trend which allows more natural ventilation. It has a cooling effect creating 24 h thermal comfort in the interior (Fig 4). Wind catchers also give an excellent passive ventilation system. The height of these towers gives these buildings and eventually the city its signature cultural city image (Fig 5). Mashrabiya controls air current into the building hence regulating the temperature indoors and does away with sun glares and radiated sunlight with a shading effect that screens the interior from the harsh sun outside (Fig 6).



بيت حلاوة في العجمي

Fig 4: Domes and vaults in Halawa house [11].



Fig 5: Traditional wind tower in Gulf states [12].



Fig 6: The traditional mashrabiya [12].

### 5.2 Contemporary Interpretation Trend:

The contemporary interpretation trend expresses the vernacular approach in a modern and contemporary way using updated technology and materials. This trend best suits the notion that contemporary architecture is a continuum of vernacular architecture and that it can be integrated into our 21<sup>st</sup>-century buildings and designs without compromising

each other in harmony, a compromise between the two extreme sides of architecture. “Its intentions are the most appropriate for the current dilemma of Arab architecture. Followers of this approach need to understand perfectly the heritable values in traditional architecture as well as the aspects of the modern age with its generalities. Then, they need to recruit these values and elements and fuse them together to create the appropriate regional identity” [8].

### 5.2.1 Features of this trend:

A feature of this trend is the re-invention of the vernacular mashrabiya through a contemporary understanding of its concept, form, and functionality (Fig 7 & 8). The reuse of wind towers also is another feature dominating this trend (Fig 9). This trend thus reinvents the conventional vernacular systems of passive cooling into an innovative and contemporary take on them.



Fig 7: Elevation of the residential units [13].

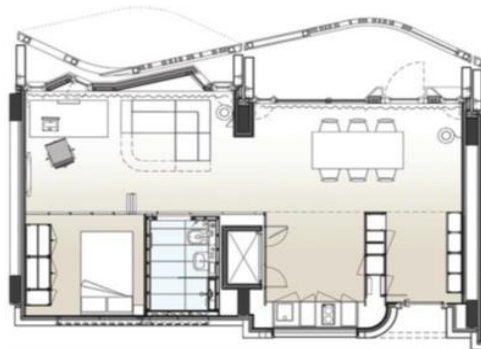


Fig 8: Plan of the residential unit [13].



Fig 9: Wind tower in the housing courtyard [13].

## 6. CASE STUDY

### 6.1. Masdar City Institute Housing, UAE:

Masdar City was started in 2008, with a bold ambition to develop the world's most sustainable eco-city. It is successfully pioneering a "green print" for how cities can rapidly urbanize while reducing energy, water, and waste consumption [13]. It is being regarded as the first sustainable city in the Middle East while presenting perfect ways of using advanced high tech in sustainable housing design. Phase one of the institute campus comprises of 102 low-rise living residential apartments (Fig. 7).

Apartments are accessed through fully shaded walkways and corridors where the thermal mass is regulated by natural ventilation and cooled air from the contemporary take of a wind catcher in the courtyard (Fig 9 and 10). Diffused daylight enters from the roof lights, blocking direct sunlight and providing additional roof area for photovoltaic panels that harness the sun's rays using clean energy generated on site from rooftop solar technology and one of the largest photovoltaic installations in the Middle East [13]. The apartments have a contemporary take on the mashrabiya on windows located near the ceiling to maximize natural light (Fig. 7 and 8).



Fig 10: The main housing courtyard [13].

## 7. DISCUSSION

Architects when designing and building, have always considered the climate of the region and the site prior to the industrial revolution, which led to the introduction of mass production of steel, glass and the application of concrete. The Middle Eastern architecture was using several systems of passive cooling that provided the dwellers of this region comfort and satisfaction regardless of the harshness of the hot and dry conditions they live in.

Post-industrial revolution and now into the 21st century, the contemporary architecture of the Middle East has neglected these vernacular systems of passive cooling and favored machines and fuel to heat up, cool and aerate or ventilate their spaces and architecture, not considering their negative effect on the environment resulting in carbon emission as well as a departure from their identity and heritage.

A strong movement is brewing in the Middle East in search of their lost identity and culture and a realization of the importance of using sustainable methods of ventilation, energy consumption to preserve the environment for the future generations. These reasons have led the region to review their vernacular systems of cooling and hence looking for innovative ways to reintroduce these systems into their contemporary building methods. The benefits of reinventing these vernacular passive cooling systems into the contemporary architecture are economic, environmental, social and cultural.

In the case Masdar city, in the United Arab Emirates, the main goal besides creating a sustainable city is to do so by introducing the vernacular architecture as a facilitating backbone to achieve this sustainability goal especially in building the architecture of the city. The wind catcher, for example, is used to cool the streets and courtyards of the city center (Fig 9). This by itself is an innovative take on a classic vernacular system used to cool the interior of houses and buildings and directing its functionality on a city scale. A sole function of a wind catcher as explained is to redirect wind energy creating a continuous ventilation hence the cooling effect on its part in this hot middle eastern region that requires constant cooling. It is a passive cooling system thus no energy is required to operate it.

Mashrabiya's are also used in Masdar city in a reinvented new way. The functionality of a mashrabiya stands yet the choice of material and the shape is quite a departure from the traditional wooden rectangular lattices. It screens the interiors from the direct sunlight, glare and allows cooled air and natural light into the spaces as well (Fig 7 and 8).

This innovative take on the mashrabiya is a fitting solution for high and low rise residential buildings in the Middle East and many contemporary takes on it is visible throughout the region. Al Bahar towers in Abu Dhabi, UAE by Aedas Architects takes the mashrabiya concept into a responsive façade [14]. Another take on a mashrabiya is commissioned by King Abdullah University of Science and Technology (KAUST) Red Sea harbor at Thuwal, in the Kingdom of Saudi Arabia in a form of a lighthouse [15]. Zaha Hadid also interpreted the mashrabiya into her futuristic metro station design in the Kingdom of Saudi Arabian capital, Riyadh. She incorporated golden lattice that filters sunlight and promotes natural ventilation [16].

Masdar City takes on the contemporary interpretation approach which is a harmonious integration between vernacular and contemporary architecture. It serves as an ideal model for a 21st-century architecture that has not rejected its culture and heritage, instead it embraces it and proudly showcases it to the world. Not only does it address the issue of cultural identity and heritage loss, it also is an exemplary model in championing environment awareness and sustainability, both problems the 21st-century architecture world is facing.

## 8. CONCLUSION

The 21st-century advancements in technology and science have been a positive milestone in our timeline but have also been controversially plunging us into a conflicting path with the environment, deeply contributing to climate change and a sad loss of identity. This is particularly due to the fact that a lot of energy is being directed into our buildings to heat and cool up the spaces in them. Nowadays, the availability of new materials such as waterproof membranes, insulations, and glazed glass, with a numerous abundance of different types of shading devices help enhance thermal comfort in the built environment.

We need to find a suitable solution to protect the environment against pollution and global warming. Vernacular architecture, a result of simplicity and modesty led our ancestors to create different dwellings to fulfill their human needs designing with the respect to nature and humility to surrounding. It has proved in the past to work well suited for the hot and dry climate of the Middle East and thus can be adapted and integrated into our 21st-century architecture. According to this study, vernacular architecture can be a sustainable tool not only because of its environmental benefits but also in improving thermal comfort, have many economic benefits and a reunion with culture and heritage. The lessons from traditional and vernacular architecture in the harsh conditions of the hot and dry region are valuable and need to be emulated. In conclusion, the fact that its advantages over our contemporary solutions of cooling our interiors of our buildings in the Middle East are enough for the 21st-century architecture to try and incorporate and integrate it into their designs and buildings.

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