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The Impact of Environmental Climatic Conditions in the Mediterranean (A Comparative Between Egypt and Spain)

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ABSTRACT

The Mediterranean refers to an expanse of space, countries and regions bound by and within a proximal distance with the Mediterranean Sea, which is a sea which connects to the Atlantic Ocean and surrounded by what is called the Mediterranean Basin. In general, Mediterranean climate is a temperate kind of climate, especially in areas of the Mediterranean basin, this climate type can also be found in other parts of the world. For this reason, the present study conducts an analysis of the interaction to demonstrate the complementary correlation between climatic conditions and the environment in both Egypt and Spain. The study's contribution is to scrutinize the tangible connection between the Mediterranean, their architectural surroundings, and the strategies employed to navigate through the shared and distinct environmental impacts. The Mediterranean region can be largely divided based on the climatic conditions and the geographical location with respect to the varying climate of these locations as; Northern and Southern divides or parts of the Mediterranean. This study applies the qualitative approach using illustrative qualitative analysis and comparative methods of climate-responsive vernacular strategies used in (indigenous) vernacular architecture in the Mediterranean. The vernacular architecture of the Mediterranean is popular for its practical, effective, sustainable, climate-responsive and environmental building effects. The aim of the study is to understand the similarities and differences between the strategies used to learn from knowledge and vernacular techniques in order to optimally adapt contemporary buildings to the environment, climate, and culture. Hence, the conclusions drawn in this paper establish fundamental principles and benchmarks for delineating the climate-responsive and environmental impacts of new architectural designs in coastal cities. This approach is tailored to suit the natural, social, and environmental context, ensuring compatibility with future development and reinforcing the local architectural value.

1. INTRODUCTION

The Mediterranean refers to an expanse of space, countries and regions bound by and within a proximal distance with the Mediterranean Sea, which is a sea which connects to the Atlantic Ocean and surrounded by what is called the Mediterranean Basin. It is bound to the north by Southern Europe and Anatolia, the south by North Africa, the east by the Levant. While Egypt, is a country in the northeastern part of Africa and one of the Mediterranean countries of the world. The expanse and stretch of the Mediterranean basin, covering a span of a plethora of territories, cultural diversities and ethnicities, offers variants of architectural milestones, designs and presentations throughout the coasts.

The Mediterranean region can be largely divided based on the climatic conditions and the geographical location with respect to the varying climate of these locations as; Northern and Southern divides or parts of the Mediterranean. The northern Mediterranean is mostly experiences between warm-hot temperatures, reasonably dry summers, leading to spells of occasional droughts, with winters having relatively mild and humid winters, typical of the temperate regions [1, 2]. The southern Mediterranean has sparse and scanty vegetation, due to the low precipitation and an arid hot desert climate [3]. The precipitation in Europe was recorded to be among the highest with up to 2,000 mm/year or more over the mountains and less in magnitude in some degrees further south.

One of the major climatic risks in the Mediterranean region is the threat of droughts and water scarcity. As temperatures rise and rainfall patterns become more erratic, water resources are being severely strained. Some 20% of mainland Spain is already desertified, due to climate change and human responsibility, such as overexploitation of water, particularly groundwater extraction, and 74% is at risk of desertification.

The indigenous Mediterranean architecture valued as the 21st century model for sustainable, energy efficient architectural and structural blueprint, is the outcome of a conscious, composite, persistent and concerted effort toward the sustenance of living and livelihood of man and all living things with respect to constraints (local) and the efficient

utilization of available resources. This details the need for in depth research in Spain's indigenous architecture with respect to the climate of the Mediterranean as it affects the structural and architectural patterns and the sustainability of these aspects and characteristics architecture in the Mediterranean regions [4].

The Causal Logic of Indigenous Architectural Research and Architectural Sustainability in the Mediterranean Sustainability in building design is relatively simple: use less energy, waste less water, and reduce the use of harmful chemicals. These three main principles will help you create a home that lasts longer and uses fewer resources to build.

Throughout the ages, vernacular dwellings have been reused, adapting to changing conditions and thus providing a direct link with the previous era. The sustainable identity of these dwellings comes from the incorporation of many environmental features into their design, as well as the use of local materials and resources, and the simple ways the inhabitants' needs are met. The environmental features ensure a climate responsive approach, improving the thermal conditions inside the dwellings. Spain's vernacular architecture incorporates the same principles as Mediterranean vernacular architecture, making it a typical case study of vernacular architecture suitable for the investigation described in this paper. It is worth noting that the preservation and rehabilitation of vernacular dwellings has a significant positive impact on local economies by creating local demand, preserving building crafts, and safeguarding the cultural identity of traditional settlements. As a result, adaptive reuse of vernacular dwellings is a highly sustainable method of development that addresses all aspects of sustainability.

Until recently, vernacular architecture and its environmental features in Spain were not studied and documented in a systematic manner. Meanwhile, many vernacular structures are being conserved and restored without regard for the preservation and enhancement of their environmental elements, instead emphasising their aesthetic values and appearance. As a result, there has been an increased demand for documentation of vernacular architecture and its environmental features.

Previous cognate research in context have, revealed that thermal performances of indigenous architecture in the Mediterranean climate, have been relatively good with the qualitative and quantitative building performance measurements emphasizing the use of local materials [4-7]. The methods used by indigenous vernacular architectural structures to minimize the levels of climatic conditions are reduced, and mostly independent of non-renewable energy, and do requires no special technological devices, that helps make them much more useful for contemporaneous passive building designs [8]. With a few constraints for adaptation and adopting the approaches defined by indigenous vernacular architecture for contemporary applications [9] owing to reasons ranging from varying and unpredictable weather patterns, climate change and resources over the years. Additionally, in order that contemporary buildings can be optimally adapted to the climate, environment, and culture, the aim of the article is the need to understand the need to learn from vernacular know-how and techniques. This study underscores the significance of examining the geographical importance of Egypt and Spain, particularly in relation to the distinctive architectural designs found in Mediterranean coastal cities. The focus is on understanding how these designs align with environmental and climatic conditions, thereby influencing the overall appeal and functionality of these locations. As a result, there is a call for increased attention to establishing fundamental principles and standards for defining architectural designs in newly developed residential areas along coastal cities. This emphasis is crucial due to the substantial impact such designs can have on reinforcing and enhancing the local architectural value of these regions and the specific objectives of this paper are:

- Examining the patterns of elements in the Mediterranean coastal cities of Spain and Egypt and assessing their alignment with the respective local environmental and climatic conditions.
- Establishing foundational principles and standards for the environmental and climatic conditions of residential buildings, considering both social and natural environmental factors, as well as their prospective development.

2. PROBLEM STATEMENT

With the different climate, the architecture solutions change in the building design and that rely on the encompassed environment, the major research problem could be defined as the need of studying the encompassed environment with its climate before starting the designing process in order to choose the appropriate design solutions. In other meaning, this study examines to understand the climatic and environmental advantages of the Mediterranean basin, to improve architectural and urban design criteria for the Mediterranean basin based on natural conditions, and evaluate the architecture of global Mediterranean cities based on the established criteria. The adoption of imported architectural designs has resulted in a mismatch between the architectural identity of certain cities and their surrounding environmental conditions. This has led to the loss of the distinctive architectural character that once defined these cities. Specifically, the Mediterranean coastal cities of Spain and Egypt have experienced a complete departure from appropriate architectural design styles. This deviation is attributed to the oversight of the impact of the surrounding environment and climatic factors on the architectural choices made in these areas.

3. MATERIALS AND METHODS

This paper applies the qualitative approach, using comparisons from previous literature research and findings and juxtaposing the contextual similarities and possible differences between the vernacular architecture of Egypt and parts of Europe and the climatic influence as well as the responsive strategies utilized in Mediterranean vernacular (indigenous) building design. The application based on cases-examples from Europe (Spain) as well as the northern part of the region (Egypt). The comparison was based on the comparative analysis of different passive climatic and responsive strategies to define comparisons and differences. The study seeks to comprehend the points of similarities and differences between the strategies used in these places, thereby allowing a comprehensive understanding of the hypothesis "of a possible correlation between the strategies used and the type of climate used in the Mediterranean region's vernacular architecture". See Table 1 the description of case studies.

Table 1. Illustration of case studies (Spain and Egypt)

Strategies		Spain	Egypt
Urban Features and Items	Urban Tissue and Architectural Blocks	 Architectural elements in a continuous arrangement, seamlessly integrated within a dense urban fabric	 An urban fabric characterized by a perpendicular network, shaped by the layout of historic small residential units within the city, interspersed with standalone arch blocks
	Streets and Pathways Network	 Due to the city's mountainous terrain, the streets take on an irregular width, featuring arcades flanking both sides—a reminiscent of the French Arch Style	 Vertical network streets, a consequence of the presence of aged small residential units, gave rise to traffic issues during peak hours, with conflicts arising between vehicular traffic and pedestrians
Architectural Features and Items	Architectural Style	 The majority of residential areas exhibit designs reminiscent of French arch styles	 A cohesive urban design encompasses consistent street widths, uniform heights of residential blocks, and standardized roof forms. However, within the realm of villa arch design, varied styles emerge on different facades, ensuring each villa possesses a distinctive and unique design
	Building Form and Building Dimensions	 Structures adopt a consistent rectangular form, maintaining uniform dimensions in both length and height, harmonizing with the width of the adjacent streets	 Villas are designed in a cubic shape, varying in width from 4 to 6 units, featuring a three-story structure (ground floor plus two upper floors), ensuring the height does not surpass 12 meters
	Building Materials and building systems	 Construction involved the use of bricks and wood, red tiles for roofing, ornate metalwork on terraces, and the implementation of load-bearing wall systems	 Structures are designed with an orientation facing the East-West direction, perpendicular to the city's riverfront. This arrangement exposes most villas to the prevailing northwestern wind while also providing all housing units with a view of the coastline, taking into account the city's coastal location
	Roofs	 The roofs feature a pyramid shape with straightforward vertical angles, adorned with uniformly red-colored tiles across their surfaces	 The ceiling height of housing units varies between 3 to 4 meters. Recently, for all summer houses, roofs are constructed using materials such as iron sheets, fiberglass, and gabled designs
	Openings Design	 Tall window panels, in accordance with load-bearing wall construction, feature wooden shutters and glass in openings, distinguished by their broad vertical design	 Given the coastal nature of the city, the prevalent design features wide openings with medium height and a rectangular shape. This allows the refreshing sea breeze to enter the summer housing units. Tents made of cloth cover these openings, ensuring an adequate amount of shading on the external walls

4. URBAN SETTLEMENT

An urban settlement is a concentrated settlement that forms or part of an urban area. It is a region with a high density of human-made structures. Usually, these geometric patterns are in well-detailed squares and rectangles. The urban settlement includes landscapes, green spaces, streets, pedestrians, and urban character.

The arrangement of rural dwellings is indicative of the patterns in the way houses are positioned relative to each other. The layout, shape, and size of rural settlements are influenced by the surrounding topography and terrain (see Figure 1). In light of these settlement patterns, the following are significant variations in rural settlement layouts:

- Linear Pattern
- Rectangular pattern
- Circular pattern
- Star-like pattern
- T-shaped, Y-shaped, and Cross-shaped pattern
- Double village.

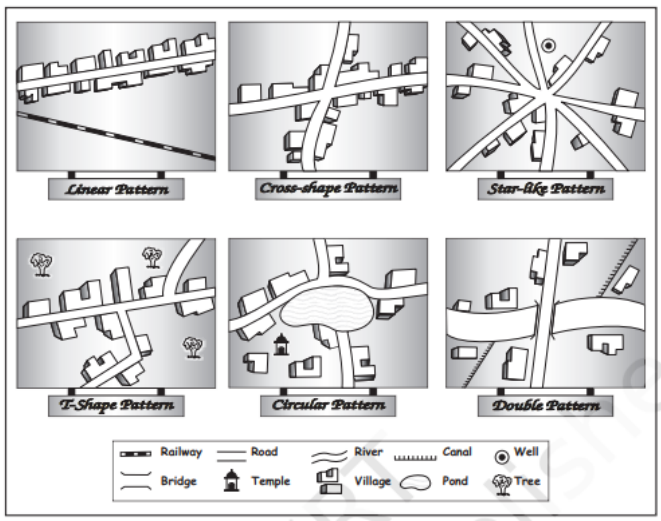


Figure 1. Settlement Patterns source: NCERT

4.1 Landscape and open areas

Landscape and open areas are used to hand with climatic weather condition by planning sites to either attract frigidness air streams to pass smoothly through open spaces to reaching the city center or prevent undesirable air in accordance with the climatic conditions of an area [10] (see Figure 2). Courtyards are used in hot and humid climates to promote and regulate air movement throughout the day [11].

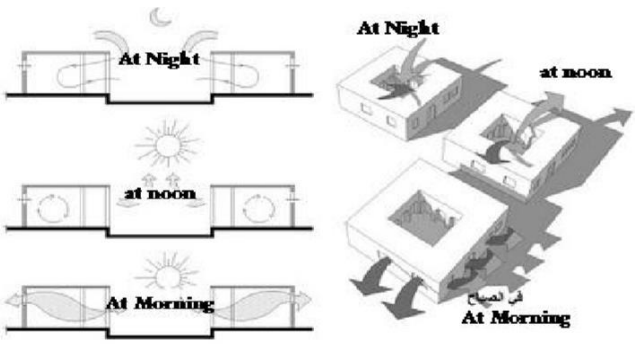


Figure 2. Courtyard as a regulator of air movement [10]

4.2 Streets and pathways patterns

Streets are the valleys of a built environment, so their shape varies according to the orientation of the buildings and in relation to prevailing winds. Humid climates prefer designs that allow air to pass, such as wide grids; while desert climates prefer a compact type with narrow streets to prevent the passage of hot air (see Figure 3). The width and orientation of streets are also influenced by solar radiation and temperature, which both affect ventilation. Table 2 shows Street orientation and relation with wind direction [12].

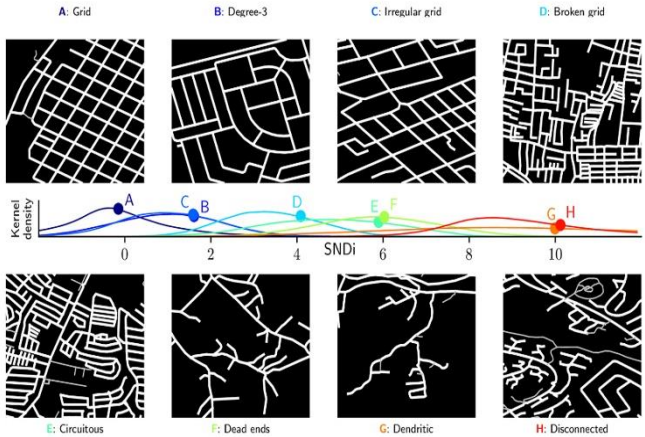
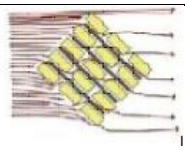
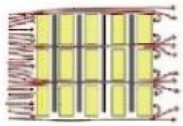
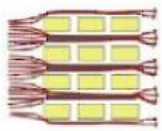


Figure 3. Orientation of streets patterns [12]

The eight types are identified and ordered by increasing SNDi using k-means cluster analysis of 30-arc second grid cells. Streets in an example grid cell near the type's centroid are shown for each type, as well as a plot of the type-level distributions (coloured lines) and means (coloured circles) of SNDi across grid cells.

Table 2. Street orientation and relation with wind direction

Streets with Inclination to Wind Direction	Streets with Perpendicular to Wind Direction	Streets with Parallel to Wind Direction
		
This configuration promotes air movement between buildings and creates a nice air stream inside building. It is, therefore, suitable for humid climates	This configuration does not improve ventilation between buildings and is preferable in hot and cold climates	This configuration promotes ease of airflow between buildings, but not inside building

5. CHARACTERIZATION OF THE MEDITERRANEAN

Different The Mediterranean climate is generally a temperate type of climate majorly from the regions, and the Mediterranean region can be largely divided based on the climatic conditions and the geographical location with respect to the varying climate of these locations as; Northern of the

Mediterranean. Mediterranean countries generally share some common aspects of vernacular/traditional architecture, like climate, building materials, and building technologies [13].

Recent studies have shown that traditional structures similar to Mediterranean vernacular architecture were found in the southern parts of Spain, Cordoba. The northern Mediterranean is mostly experiences between warm-hot temperatures, reasonably dry summers, leading to spells of occasional droughts, with winters having relatively mild and humid winters, typical of the temperate regions [2]. The southern Mediterranean has sparse and scanty vegetation, due to the low precipitation and an arid hot desert climate [3]. In the case of Europe, using Spain as a reference point, the climate is a temperate climate - Type C, according to the Köppen Geiger climate classification [14]. The territory of mainland Spain is divided into two subspecies of climate:

i) In most parts, the northern part and the western coast have a Csb climatic subspecies, which means rainy winters and dry or mild summers.

ii) The southern part has a temperate climate sub-type Csa, i.e. harsh, hot and dry summers with an average maximum air temperature value of 32-25°C and a maximum temperature of 40°C or 45°C between July and August and an average annual rainfall of less than 500 mm, the driest month being July (below 5 mm) [14].

To whereas, according to the Köppen climate classification, Egypt is located within a hot desert climate (BWh). In the northern part of Egypt, the climate is the warm Mediterranean climate, which is completely different from the climate of the remaining parts of the desert regions of Egypt. The temperature here ranges from a minimum of 9.5°C in the winter to 23°C in the summer and a monthly average of a maximum of 17°C in the winter and 31°C in the summer. The average annual precipitation is around 200 mm. The prevailing Mediterranean winds have a great influence on the northern shoreline temperatures, making the summers moderately hot and humid and the winters humid and moderately. Temperatures vary widely in North Africa and the Middle East, with the average temperature ranging between 18 and 28 degrees Celsius. During the winter season, usually from December to February, in the northern parts of the Mediterranean, the average temperatures are below -5°C, while in the south they usually reach 15°C. In contrast, the summer periods from June to August are warm, with temperatures ranging between 25°C and sometimes more than 40°C in some areas.

The arid climate in Egypt and Spain, characterized by high temperatures and low humidity, significantly influences architectural choices for insulation. In both regions, traditional construction materials like adobe and mud bricks are common due to their thermal mass properties, aiding in temperature regulation. Central courtyards are a prevalent feature in traditional Egyptian houses, promoting natural ventilation by allowing hot air to rise and escape while drawing in cooler air. Similarly, in arid regions of Spain, adobe construction is popular for its thermal mass, helping regulate temperatures. Both regions incorporate design elements such as small windows, thick walls, balconies, and patios to minimize direct sunlight and heat gain, promoting more stable indoor temperatures. In sunny areas like southern Spain, buildings often include shading elements like arcades or overhanging eaves to protect against intense sunlight. Additionally, white paint is used in some areas to reflect sunlight and maintain cooler interiors. Overall, the vernacular architecture in Egypt and Spain reflects a deep understanding of local climatic conditions, utilizing indigenous materials and design principles to create comfortable living spaces adapted to the environment, influenced by both cultural and historical factors (see Figure 4) map illustrates the location of the Mediterranean.

Figure 4. Map illustrates the location of the Mediterranean, Spain, and Egypt [15]

6. RESULTS AND DISCUSSIONS

6.1 The impact of the mediterranean climate on vernacular interior and exterior architecture

A comparison between the climate-responsive strategies applied in the vernacular interior and exterior architecture of northern Egypt and Spain. Summarily, the strategies have been presented above. After much comparison, there have been significant similarities noticed between the vernacular structures of the architecture of Egypt and Europe in spite of the sheer distance between Egypt & Europe and the opposite positioning in the Mediterranean basin, which are basically due to the influence of the Mediterranean climate and the residual effect of a common Europe and Arab cultural effect. The strategies utilized in the two region are very similar. In comparison, the aforementioned influences are generic to Egypt and Europe, on both divides of the Mediterranean. Use of heavy thermal mass materials to inhibit heat flow, use of light colors, reducing the size of windows-openings, use of building envelopes and materials, natural ventilation and shading, patios, water and vegetation in an urban layout and building orientation serves both regions in coping with the climatic demands and the satisfaction of the specific human needs that arise from the weather extremes in protection, comfort and shelter provision as it affects the general life architecture of the people [16].

The Mediterranean vernacular architecture is popular for its practical, effective, sustainable building effects that are responsive to the climate and environment [17]. In the nineteenth and twentieth centuries, when ready-made, efficient, sustainable and renewable energy was not common or readily available and energetic systems were not in place, experiments and development of passive genius systems were carried out to improve luxurious interior amenities and respond to specific human needs to address the challenges of climatic conditions with available resources [17-20]. The Mediterranean climate has thus influenced the vernacular architecture of the Mediterranean regions by;

- Informing the use of urban layout and building orientation in regions with hot summer periods, thus

minimizing heat gains in the summer while reducing internal heat losses in the winter periods. Narrow streets and galleries provide shade to protect walkers from the harsh summer season [21].

Table 3. Climate response strategies utilized in the vernacular Interior & Exterior architecture of northern Egypt and Spain

Strategy	Description	Northern Egypt	Spain
Urban layout and building forms present	A compact urban layout which gives cover and reduces the surface area exposed to the sun. Compact building forms and the presence of patios are common in the urban layouts	Yes	Yes
	Pedestrians are protected from the scorch of the hot summer sun with the presence of narrow streets, which are covered like galleries	Yes	Yes
	The building orientations are such that, the buildings use the southern quadrant to increase solar gains during the winter and decrease them during the summer [22]	Yes	Yes
Shading and use of natural ventilation	Screens (mashrabiya) or vegetation are used for proper shading for windows when there's no need for heat gains	Yes	Yes
	Grids are used to air cross air ventilation and circulation, to foster the privacy and thermal comfort of the occupants	Yes	Yes
Use of small openings	Minimal opening in size and number helps to reduce heat gains	Yes	Yes
Evaporative cooling	Air cooling by water evaporation is achieved by the use of fountains and pools, which are usually located in courtyards and monasteries	Yes	Yes
Vegetation	Provision of shades, increase in air moisture through the process of evapotranspiration, is done using vegetation into cool air streams before reaching the building	Yes	Yes
Materials and thermal mass	Local materials used, such as earth and stone, are ideal for the local climate. Good temperature storage capacity stabilizes the interior temperature (cool through the day and warm at night).	Yes	Yes
Buildings colours	Light colours for building envelopes the roof, helps to reduce heat gains by reflecting solar radiation.	Yes	Yes

Figure 5. A graphic design of an urban layout highlighting streets and compact buildings

Figure 6. Use of light colors [23]

• As shown (Figure 5), encouraging heat stress alleviation strategies using patios, water and vegetation: the use of patios and eco-friendly vegetation has recently become prevalent. The presence of European and Arab cultures in both nations is related to these passive cooling strategies (Egypt and Spain). An experiment conducted in Spain during the summer showed that the air temperature in the patio always remained lower than those recorded for the city center due to the effect of evapotranspiration and plant shades and canopies and evaporative cooling of water, Maximum 9℃ during the day [23].

• Promotion of natural ventilation and shading: an important passive strategy in a warm climate is the promotion of natural ventilation for overnight cooling. Several techniques have been incorporated to create natural ventilation in windows, doors, or walls. By taking advantage of the cool air at night, the ventilation openings allow simultaneous shading of light and intense radiation without compromising privacy and security [23]. There are many applications of using vegetation as shades, not only as floor shades but also as pergolas and screen shades for different façades.

• Informing the use of building envelopes, materials and colors: building envelopes are like shells on the major points of contact of the building with the outer environment, hence of thermal performance on indoor environment (see Figure 6). In the Mediterranean hot climates of the southern summers, the envelope mitigates the effects intense solar radiation on indoor comfort. Some of the other strategies to mitigate the effect of extreme climates as dictated by the demands of the climates of the Mediterranean includes: (A). Decreasing the size of windows-openings, and withdrawing them into the façade to get extra shade. (B). the use of light colors used on these façades also influences indoor temperatures [24]. White painted traditional surfaces (facades, terraces, and floors) are an important element to mitigate solar radiation, allowing about 90% percent of all received radiation to be reflected [21]. (C). Heavy thermal block materials to dampen the heat flow.

As shown (Figure 7), the structure demonstrates that the natural ventilation has been further improved by the difference in air density induced by the contrasting temperature that, providing a natural flow to the upper exhaust vents and thus

the cool air is drawn in from the lower vents. This is particularly suitable for night disinfection and early morning pre-cooling cycles in warmer climates.

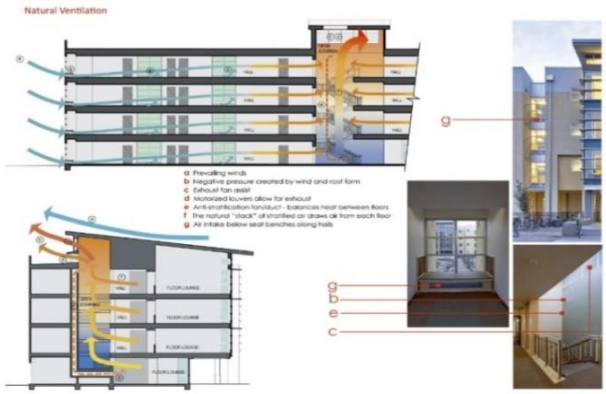


Figure 7. Natural ventilation strategies inside the building

Figure 8 Cooling and Heating Strategies shows the concept of "the use of small openings" in Table 3.

The high molecular and structural mass of stone and earth made into rammed earth and block moulds allows for appropriate response to the scorch of the extreme Mediterranean sun in the summer. This is consistent with the reports from several other studies, that the good heat storage of the materials (earth and stone) as shown in the (Table 4) helps to stabilize the ambient indoor temperature and moisture [25, 26]. The thermal conductivity, thermal conductivity, thermal storage capacity, shows the heat retention and dissipation ability of the traditional building materials of vernacular architecture in the Mediterranean region. These materials keep the interior cool during the warm days and warm during the cold nights. This alongside the possibility of recycling the stones, are the merits of using these materials [27]. The deployment of materials from the same local climate and soil typology has a better adaptability, durability and longevity as well as economical and lesser environmental impacts than the use of the traditional materials synonymous in most parts of Europe.

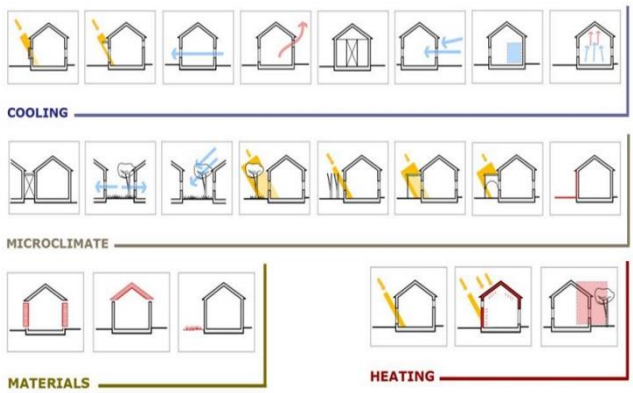


Figure 8. Cooling and heating strategies

Table 4. Characteristics of some vernacular and traditional building materials [28-30]

Material	Density (kg/m^3)	Thermal Conductivity-Value (W/m.°C)	Thermal Storage Capacity (Wh/kg°C)	Heat Transfer Time Lag (250 mm Thickness) (hour)	Embodied Energy ($MJ\ eq./m^3$)	Global Warming Potential ($kg\ CO_2\ eq./m^3$)
Rammed earth/adobe	1770-2000	1.00-1.20	0.23-0.30	10/9	943	38
Stone	2600-2800	2.30-3.50	0.22-0.24	5.5	1300	26
Concrete	2400	1.80	1.10	7	1450	264
Hollow bricks	1200	0.39-0.45	0.26	6	4245	357

Lastly, because of the relationship between natural and social environments, it is critical to understand the traditional way of life in each studied region.

Integrating traditional strategies into modern building designs offers benefits like sustainability, cultural preservation, and a connection to local environments. However, challenges arise from technology, cultural differences, and conflicting design principles. Key considerations include passive design for enhanced energy efficiency, the use of locally sourced materials to support economies and reduce environmental impact, and the complexity of integrating modern building systems like HVAC and security while maintaining aesthetic and functional integrity. Navigating building codes and regulations poses challenges, and adapting traditional strategies to modern climate challenges is crucial for building resilience [31].

In the case of Spain, several historical factors must be considered, such as the dominance of minifundia smallholding or latifundia as agricultural exploitation. Each region's influences are different, including Celtic or Iberian, Roman, Visigothic, and Islamic cultures.

This item describes some differences in social, economic, or folk way of life that are necessary for understanding the typological function of dwellings or architectural elements such as windows, balconies, and so on. The cultural and historical past is relevant in the forms of vernacular architecture and the inhabitants' proclivity to select materials and techniques. Thus, analysis of the environment and climatic factors must provide knowledge of all these factors that determine the place and its influence on architecture. Wind, rain, temperature, and solar radiation all influence not only the location of settlements near water sources, but also the layout and characteristics of vernacular buildings. Bioclimatic chart is used to assess the urban adequacy of the settlement to climatic characteristics. This tool also serves to determine the adequacy of the adopted strategies when there are changes in the town's planning and historical changes. In this sense, the use of Olgyay's bioclimatic chart allows us to assess how these changes have affected or not affected modern urbanism and its influences on traditional buildings [32]. This analysis is completed with a look at the hygrothermal (temperature and humidity) behaviour of vernacular dwellings' interiors using

Givoni's chart [33].

Sustainable architecture seeks to tackle modern challenges in the environmental, social, and economic aspects of building design. Utilizing vernacular strategies, such as local materials, traditional construction methods, and indigenous knowledge, proves crucial for sustainable practices [34]. These strategies address various issues:

Local Materials and Resources: Emphasizes the use of nearby materials to reduce energy in transportation and support local economies.

Climate Responsive Design: Leverages traditional designs for optimal natural ventilation, shading, and insulation, minimizing reliance on mechanical heating and cooling.

Adaptation to Climate Change: Draws on indigenous knowledge to create resilient designs, helping buildings withstand natural disasters.

Energy Efficiency: Promotes passive solar design, orienting buildings to maximize natural light and warmth, thereby reducing the need for artificial lighting and heating.

Cultural Context and Social Sustainability: Preserves cultural identity and fosters community ownership by incorporating local design elements.

Water Conservation: Integrates traditional water harvesting techniques like rainwater harvesting and greywater reuse to encourage water conservation in contemporary designs.

Waste Reduction: Encourages efficient material use and adaptive reuse principles to minimize construction and lifecycle waste.

By incorporating these vernacular strategies, contemporary architects can effectively address sustainability challenges, resulting in environmentally responsible, socially inclusive, and economically viable buildings.

7. CONCLUSIONS

It After much comparison, there have been significant similarities between vernacular structures of the architecture of Egypt and Europe in spite of the sheer distance between (Egypt & Spain) and the opposite positioning in the Mediterranean basin, which are basically due to the influence of the Mediterranean climate and the residual effect of a common Europe and Arab cultural influence. The strategies used in the two regions and purpose are very similar. Due to the climate characterized by hot and dry summers, these strategies are oriented more towards the purpose of passive cooling. Besides that, some of these strategies are debated below.

The use and dependence on fossil energy over the longevity buildings because of the reliance on mechanical means to control interior climate has resulted in several defects in initial the structural integrity of buildings as it pertains to climate and the rising cost of running periodical maintenance is quite a burden. Climate temperature is a significant issue to consider in designing a structure of the building. This study indicates that, despite the existence of many vernacular architectural structures in Mediterranean region, it is increasingly challenging and relevant to the observation that the traditions of local architecture and qualitative design knowledge are transformed into modern sustainable building designs. Architects and engineers alike should learn to not only rely on mechanical means and pick knowledge from the vernacular strategies and make conscious efforts towards getting the best out of low energy and natural climatic control of their buildings while using the mechanical and active systems as supplementary aids, maximizing resources to meet the comfort needs of occupants. By optimization these strategies, it should possible to meet the required comfort standards while reducing fossil energy consumption.

In examining the influence of environmental climatic conditions in Egypt and Spain, this study aims to provide valuable insights into the challenges and opportunities inherent in the Mediterranean region. It is imperative to comprehend the intricacies of each country's approach to climate-related issues, as this understanding is pivotal for nurturing regional collaboration and devising impactful strategies to tackle common environmental concerns. The nuances in responses underscore the importance of tailored solutions. As we move forward, additional research and collaborative efforts are essential to guarantee the resilience and well-being of Mediterranean countries in the face of future environmental challenges.

The recommendations for further research are: (1). Added extensive research and quantitative studies are necessary to adapt passive vernacular strategies for modern applications and adoption. (2). Principles of vernacular strategies must be applied for effective guidance, contemporary urban designing, and building design regulations.

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