



DOI: <https://doi.org/10.38027/ICCAUA2025EN0372>

## Sustainable Architecture in Egypt: A Historical Analysis

\* <sup>1</sup> Ph.D. Candidate **Sara Alansary**, <sup>2</sup> Dr. **Dalia Abdelfattah**

<sup>1</sup> Department of Architecture, Faculty Of Engineering, Ain Shams University, Egypt

<sup>2</sup> Department of Architecture, Faculty Of Engineering, Al Yamamah University, KSA

E-mail <sup>1</sup>: [sara.alansary@eng.asu.edu.eg](mailto:sara.alansary@eng.asu.edu.eg), E-mail <sup>2</sup>: [d\\_fattah@yu.edu.sa](mailto:d_fattah@yu.edu.sa)

### Abstract

**Received:** 7 February 2025  
**Revised:** 28 May 2025  
**Accepted:** 18 June 2025  
**Available online:** 5 July 2025

Copyright © 2025 by the author(s).  
All rights reserved.

This article is published under an open-access model and is made available in accordance with the terms of the Creative Commons Attribution 4.0 International Licence (CC BY).



The publisher maintains a neutral stance concerning jurisdictional claims in published maps and institutional affiliations.

This article has been selected and peer-reviewed for publication in this journal as part of the 8th International Conference of Contemporary Affairs in Architecture and Urbanism, held on 8–9 May 2025 in Alanya, Türkiye.

The growth of what we may, in the present context, describe as "unsustainable architecture" began with the industrial revolution, as more and more new technologies were incorporated into the fabric of buildings. Before all these developments most buildings employed the properties of material and form to provide appropriate relationships between their uses and the environments. In other words, Buildings of the past were sustainable. This paper will present the background of Sustainable Architecture features in Egypt by studying ancient Egyptian architecture to address sustainability features through architecture heritage with focus on the ancient civilization and Islamic civilization in Egypt. The research methodology encompasses the establishment of criteria for evaluating sustainability of architectural products, followed by a comprehensive review of these products during periods under study. Furthermore, the historical approaches towards sustainable architecture examined allows the formulation of recommendations aimed at enhancing contemporary Egyptian architecture.

**Keywords:** Sustainable Architecture; Architectural Heritage; Historical Sustainability Practices; Egyptian Architecture.

### 1. Introduction

The growth of "unsustainable architecture" began with the industrial revolution at the end of the 18th century, as new technologies were incorporated into construction industry. Before these developments, buildings used form and material properties to provide healthy relationship between buildings and the environment. Architects were intimidated by environmental and social problems. The survival of many historic buildings today significantly complements this entire concept. In other words "Buildings of the past were sustainable". With this motivation, this paper will present the background of Sustainable Architecture in Egypt by studying Egyptian architecture to address the emerging attempts towards sustainability through architecture heritage this will be studied by assessing the architectural products with the modern sustainability metrics.

#### 1.1 Background and Context

Having central location on routes of trade, Egypt had experienced several conquests and migrations throughout the centuries of its recorded history; it hosted many temporary and permanent residents. Egypt has hosted many great civilizations since its origin, which all had an impact on multilayer of various cultures as well as forms and concepts of vernacular architecture and concepts of architecture, thus leading to Sustainable Architecture. However, ancient Egyptian Civilization is a rich one; the Egyptian civilization has a permanent character as endured for thousands years. The Ancient Egyptian Civilizations endured many magnificent achievements on so many fields. On the other hand, the Arab conquest and the Islamic era in Egypt touch modern Egyptian as they are nowadays living its continuum. Egypt was transformed to a Muslim country; only slowly over time. Arabic language and culture were then adopted by all Egyptians. From the time of the conquest onward, there was a strong correlation between Egypt's history and the history of the Arab world Therefore Ancient Egyptian civilization and Islamic civilization are considered as the most influential eras in forming the Egyptian identity. This study focuses on studying the architectural product of both eras. Since the Sustainable Development requires environmental, economic and social well-being, so the economical and social factors will be studied as well for having important effects on the architectural products.

#### 1.2 Research questions and Objectives

The study hypothesis that the Egyptian Architectural heritage is rich in many Sustainability contributions that are worthy of study and documentation. It represents an important reference for the sustainability of the local contemporary architecture. The main questions this studying is tackling are How the Egyptian Architectural heritage applied the

concept of sustainability as it is known nowadays? And how do aspects of sustainability - if any - differ across different historical periods? The study aims at analyzing how past architectural practices aligned with modern sustainability principles, Identify key sustainability contributions from different historical periods and to study appropriate solutions derived from the past attempts for sustainable architecture in Egypt.

### 1.3 Methodology and Structure of the Paper

This research systematically analyzes sustainable architectural residential buildings in the Egyptian history by defining sustainable building criteria, analyzing historical architectural buildings, evaluating buildings, and proposing recommendations for reintroducing sustainability principles into contemporary Egyptian architecture, focusing on energy efficiency, material use, and environmental impact. Figure 1 illustrates the study process.



Figure 1. Study Process (Developed by Author).

## 2. Materials and Methods

This research follows a structured approach to analyze and document sustainable architectural practices throughout Egypt's history. After an extensive literature review the research process consists of the following steps:

1. Defining Sustainability Criteria: after extensive literature review that aims at establishing evaluation benchmarks based on environmental, economic, and social sustainability.
2. Historical Analysis: Reviewing architectural developments across different historical periods, focusing on residential buildings.
3. Building Analysis: Evaluating historical buildings based on the established criteria, assessing their energy efficiency, material use, and environmental impact.
4. Proposing Recommendations: Based on the historical analysis, suggesting strategies to reintroduce historical sustainability principles into contemporary Egyptian architecture

## 3. Literature

### 3.1 Sustainability in Architecture

The principles of sustainable development were identified by the Millennium Declaration as environmental protection economic development and social development. Hence, sustainable development is a whole system of growth and development taking into consideration managing natural and produced resources and social welfare of current and future generations.(Hickmann et al., 2023) The sustainability concept has become the idea of three main aspects; environmental, economic and social sustainability. Sustainability is achieved by the integration of all three aspects; however they cannot be treated equally. First of all economy is a mechanism that is created by society while the environment includes both society and economy. And the relationship between environment, society and economy must be governed through human rights.(Purvis et al., 2019)

Environmental Sustainability refers to using the renewable natural resources without compromising its extinction or degradation or decreasing its viability for future generations while preserving non-contradictory constant balance of natural resources such as soil, ground water and biomass (Afara et al. 2024; Amen, Afara, and Muhy-Al-din 2024) . In addition to, satisfying basic human needs like the availability, quality of water, air, food and shelter taking into consideration the human health.(Islam 李伊凡 & SHUWEI, 2023) Economic Sustainability refers to the usage of available resources to their best advantage in a way that is both efficient and responsible providing long-term benefits without diminishing the chances of future generations of enjoying consumption level, wealth or welfare compared to those enjoyed by present ones, taking into consideration that social, environmental, health wellbeing and financial aspects have to be integrated. Social sustainability refers to social equity, where policies and activities support the social and cultural spirit of a place and its people, resulting in an improved quality of life.(Dabija, 2020) Social sustainability refers to individuals, communities and societies living together in places that promote wellbeing by supporting cultural

and social life through social amenities for citizen involvement, progress and growth. Equity is the social pillar of sustainability that promotes equality in a society amidst social and economic disparities. (Wang & Ke, 2024)

### **3.2 Sustainable Design Aspects**

The building affects the local and global environments during its lifetime by series human activities and various processes. Before the construction process the manufacturing of materials impacts the global environment. During construction, although it can be considered as a temporary condition, construction equipment, working force and process of construction affect the local ecology. After construction, building operation process affects the environment. The key solution for minimizing the building effects is the sustainable design. The sustainable design goal is to provide architectural solutions that comprise the three bottom line of sustainability. (Dabija, 2020)

Sustainable buildings are buildings that incorporate the principles of a conscientious handling of natural resources. The consequences will be causing minimum possible environmental interference, using environmentally friend materials, indoor solutions that need low energy requirements, renewable energy use, high-quality guideline for construction, social wellbeing and economical operation. This could be achieved through an integrated approach that allow better handling of the architectural design, support structure, façade, building physics, building technology, energy and occupants. (Poorisat et al., 2024) Different international and local assessment such as LEED, BREEM, DGNB and Green Pyramid were designed following that sustainable design incorporates six main aspects considered as guidelines for whoever involved in the sustainable construction industry. (Liu et al., 2022)

#### **3.2.1 Sustainable Site Design**

The sustainable sites design addresses environmental issues related to building landscape, hardscape and exterior building issues. Buildings must suit its location; studies must be made to obtain an understanding of local conditions. Important aspects to consider are the natural surroundings, climate, social structure and human activities. (Akolade & Alli, 2018)

#### **3.2.2 Water efficiency**

The main goal is increasing water efficiency use and reducing the amount of water used during operations. This could be achieved through using water efficient landscaping methods and innovative wastewater management methods. (Hafez et al., 2023)

#### **3.2.3 Energy and atmosphere**

Huge percentage of energy and electricity produced annually is consumed by the building sector; buildings consume energy for water heating, mechanical ventilation, lighting and operating machinery. Proper instalment of energy systems help reduce overall energy use and operating costs. (Hafez et al., 2023)

#### **3.2.4 Materials and resources**

The life cycle of a material starting from its extraction till its disposal have negative impacts on human health and the environment through polluting water and air, destroying native habitats and depleting natural resources. These impacts can be reduced through environmentally responsible procurement policies. Efficient use of materials reduces the amount of waste created during construction as building operations generate a large amount of waste. (Liu et al., 2022)

#### **3.2.5 Indoor environmental quality**

Indoor environment quality has a great effect on occupants' well-being, productivity and health. A building design with the best possible conditions of indoor air quality, ventilation, thermal comfort, access to natural ventilation and daylighting, and effective control of the acoustical environment. (Akolade & Alli, 2018)

#### **3.2.6 Social equity**

Social sustainability refers to the human aspect. It is the combination of the physical and the social world to support social and cultural life. Social equity promotes equality in social and economic disparities in a society. Social design of the community involves planning, design and development. It requires the integration of various city components within the urban fabric to address wellbeing, quality of life and satisfaction of residents. (Arafat et al., 2023; Clay et al., 2023; Hamedani & Huber, 2012)

## **4. Analysis Criteria for evaluating Sustainable Architectural Products**

In order to present the background of Sustainable Architecture aspects in Egypt by tracing Egyptian architecture, the architectural product through the different periods will be studied and criticized by the same criteria. The evaluation criteria was developed through the integration between different assessment methods; LEED, Green Pyramid and DGNB. (Arafat et al., 2023) (Clay et al., 2023) (Hamedani & Huber, 2012) taking into consideration the unique characteristics of the ancient times.

### **4.1 Format and Layout of the Evaluation Criteria**

The Evaluation criteria balance mainly on three major aspects: the Environmental aspect, the Economical aspect and the Social aspect. Each aspect comprises series of categories which in turn contain sub-categories. (Table 1) shows the evaluation matrix to be used for building analysis.

**Aspect A: Environmental Health**, The goal of this aspect is to evaluate the impact of the design and construction of the building on the environment, the presence for proper solutions that ensure the well-being and coexistence of the global ecosystem and the domain of human health such as the indoor air quality, ventilation and thermal comfort.

Categories of the Environmental health aspect:

1. Sustainable Site and Ecology
2. Energy Efficiency
3. Water Efficiency
4. Materials and Resources
5. Indoor Health Quality
6. Post-Building Use

**Aspect B: Economic Vitality**, The goal of this aspect is to evaluate using available resources to their best advantage without wasting any of them and to provide long-term benefits so that the used resources are maintained during the building life cycle and after it.

Categories of the Economic vitality aspect:

1. Pre-Building Phase economy
2. Post-Building Phase economy

**Aspect C: Social Equity**, The goal of this aspect is to evaluate built environment whether it balances between the individual and the group and offers connections between individuals within the building and between occupants and the surrounding community, besides achieving the social sustainability aspect’s goals.

Categories of the Social Equity aspect:

1. Social and functional diversity
2. Community services
3. Employment
4. Neighborhood rights
5. The integration of societal gradients

**Table 1.** Evaluation matrix.

Evaluation Matrix		
Category/ Sub Category	Description	
<b>A Environmental Health</b>		
A.1	<b>Sustainable Site and Ecology:</b> Addresses environmental issues related to building landscape, hardscape and exterior building issues. Buildings must suit its location and local conditions; the natural surroundings, climate, social structure and human activities.	
	A.1.1 Site Selection	Projects that redeveloped in informal areas and avoiding negative effect on protected areas.
	A.1.2 Preservation of Natural Conditions	Buildings that respected topographical contours or preserved existing flora and fauna.
	A.1.3 Accessibility to basic needs	Proximity of the site to daily basic needs (food, education, etc.)
	A.1.4 Building Exterior and Landscape	Energy conscious site planning by using passive heating and cooling methods.
	A.1.5 Heat Island Effect	Reducing heat islands.
	A.1.6 Minimising pollution during constructi	Buildings that minimised pollution from construction operations.
A.2	<b>Energy Efficiency:</b> Usage of renewable energy and passive techniques to reduce energy consumption.	
	A.2.1 Alternate Sources of Energy	Building used Solar, wind, water, and geothermal energy systems.
	A.2.2 Daylighting	Building whose openings design that utilizes natural lighting.
	A.2.3 Insulation	Building used wall insulation prevented both heat gain and loss.
	A.2.4 Choosing Materials with Low Embod Energy	Building used materials with low embodied energy
A.3	<b>Water Efficiency:</b> Targeting water efficiency use within the building.	
	A.3.1 Water Efficient Landscaping	The building that the use of potable water for landscape irrigation was Limited or eliminated.
	A.3.2 Indoor Water Efficiency	The building that had a sensible reduction in indoor potable water consumption by the use of conserving water and sanitary fixtures.
A.4	<b>Materials and Resources:</b> This category evaluates the Selection of materials with a low environmental impact, particularly; Regional and local materials, Renewable materials and Recycled materials.	

	A.4.1 Regionally procured materials	The building whose materials were extracted and manufactured in Egypt.
	A.4.2. Materials fabricated on site	The building comprised building materials (such as bricks) that are fabricated on site.
	A.4.3 Use of readily renewable materials	The building comprised building materials that are readily renewable such materials include earth materials, natural stone and etc.
	A.4.4 Use of salvaged materials	The building that used re-used building materials.
	A.4.5 Use of recycled materials	The building that used recycled building materials.
	A.4.6 Use of Nontoxic Materials	The building that used nontoxic building materials.
	<b>Indoor Health Quality:</b> Provide a healthy and comfortable indoor environment for the occupants with the best possible conditions of indoor air quality, ventilation, thermal comfort, access to natural ventilation and daylighting, and effective control of the acoustical environment.	
A.5	A.5.1 Ventilation Effectiveness	Usage of Natural Ventilation techniques.
	A.5.2 Thermal comfort	The building provided by proper systems that provide a thermally comfortable environment.
	A.5.3 Use Nontoxic Materials	The building comprised with environmentally friend finishing materials.
	A.5.4 Visual comfort	The building provided by opening allows visual connection to the exterior environment & proper daylighting.
	A.5.5 Acoustic Comfort	The building with suitable acoustic conditions and noise control strategies.
	<b>Post Building Use:</b> This category evaluates environmental consequences of structures after the life cycle of the building had ended whether the building was reused or its components recycled.	
A.6	A.6.1 Reuse of the Building	The building that was adapted to new uses whether complete reuse of the building individual components was selected for reuse
	A.6.2 Recycle of Materials	The building that its materials were recycled.
<b>B Economic Vitality</b>		
	<b>Pre-Building Phase Economy:</b> This category evaluates the economy of resources during the design stage of the building.	
B.1	B.1.1 Funding Method	Using funding methods that did not cause extra charges for the building's investor.
	B.1.2 Selection of Recycled Materials	The selection of recycled materials or the reuse of building materials.
	B.1.3 Selection of Durable Materials	The selection of durable materials with the minimum maintenance cost.
	<b>Post-Building Economy:</b> This category evaluates the economy of resources after the life cycle of the building ends.	
B.2	B.2.1 Reuse of the building	Adaptation of the building into new uses or the reuse of individual components of the building.
	B.2.2 Execution of the building	Usage of crushed remnants.
<b>C Social Wellbeing</b>		
	<b>Social and functional diversity:</b> This category evaluates the availability of open spaces and recreational spaces that allow social connections between occupants, in addition to the presence of worship places for different religions.	
C.1	C.1.1 Building Footprint	Ratio of the building footprint to the site.
	C.1.2 Open Areas	The quality of the surrounding open areas within the building site for occupants use regarding the presence of greenery and privacy.
	C.1.3 Worship Places	The presence of nearby worship campuses for all religion believes adopted by the neighbourhood occupants.
	<b>Community Services:</b> This category evaluates the Neighborhood's services.	
C.2	C.2.1 Open Spaces and Community Centers	The availability of open spaces within the neighborhood.
	C.2.2 Daily Basic Needs	Daily basic needs must lie within reasonable walking distance.
	C.2.3 Educational Facilities	Presence of nearby affordable proper educational facilities.
	C.2.4 Healthcare Facilities	Presence of nearby proper health care centers.
	<b>Neighbourhood Rights:</b> This category evaluates respecting neighbour right.	
C.3	C.3.1 Achieving Privacy	Achieving privacy for the building without compromising the neighbour privacy issues.

## 5. Historical Overview

This section introduces an analytical study of the residential buildings through ancient Egyptian civilization period and Islamic civilization in Egypt including the study of the social and economic aspects during the periods under study through introducing detailed explanation of the residential buildings.

### 5.1 Ancient Egyptian Civilization

For almost 30 centuries - since the unification of the Egyptian Kingdom until it is conquered by Alexander the Great in 332 B.C. ancient Egypt was the preeminent civilization in the Mediterranean area. By this time Egypt was blessed by great weather, the Nile river that flooded regularly and fertilized soil. The ancient Egyptians pioneered in architecture building monumental temples and tombs and cosy homes as well. They developed one of the very first writing systems in the world that allowed them to keep records and create stories, poems and religious texts. The Ancient Egyptian Civilizations endured many magnificent achievements on so many fields. They had a quite social and political life. They had their religious beliefs and activities.

#### 5.1.1 Social Characteristics and beliefs

The social structure of the Egyptian society is like a pyramid with the pharaoh at the top. As Pharaohs were believed to be gods in human form, they had a strong authority. In the social pyramid of ancient Egypt the top includes the king and those associated with divinity and the bottom is made up of the scribes, soldiers, servants and slaves. The classes near the top of the social pyramid had fewer people with higher status, while the classes near the bottom had more number of people with lower status. Probably 90 % or more of ancient Egyptians existed at the bottom of social, wealth, and power hierarchies, where they worked as farmers, fishermen, potters, bakers, or other tiny professions. This affected the residential buildings as high classes led live of luxury and nobles had great wealth and fine homes, while peasants had the fewest comforts of any of the social classes forming two main types of houses Nobles' houses and Peasants' Houses. (Allen, 2008).

Religion was the dominant social force in ancient Egypt as religious influence was affecting almost everything and guiding every aspect of Egyptian life. The main important aspect of the Egyptian religious beliefs was their ideas of the afterlife which affected the residential buildings. According to their beliefs, Ancient Egyptians valued the continued existence after death. The earthly dwelling was seen as temporary and the tomb as a permanent dwelling (Home of Eternity) as they believed. Houses were built of temporary materials to last for a life time, while tombs and temples dominated ancient Egyptian architecture and were designed to last forever. (Refaat, 2024) Outside the household, local community was the social context surrounding one's life. Egypt was a village society; most of the population was gathered around a relatively small landscape. The rural settlements were placed on higher ground areas to avoid the annual flood of the Nile, and articulated by the families living within as the primary social and economic unit. Such as Amarna city pattern as small houses were grouped around the large compounds of the employers. Markets had been focal points of interaction between local communities. Awareness of interdependence in the community was expressed in many ancient scripts like emphasizing on the relations between neighbours (Allen, 2008). With that, Kadri and Husain suggests that "revising cities' structural plans should consider urban and rural populations' needs for economic activities and services" (Kadry & Husain, 2024).

#### 5.1.2 Residential Architecture Features

Knowledge of cities, towns and houses in the Ancient Egyptian periods is few with minimum traces of domestic architecture, as most of ancient Egyptian settlements were destroyed or replaced by later construction. Moreover, reed mats and mud-brick were used to build early agricultural villages, so they did not last unlike stone. As the houses of ancient Egyptians did not last, most of current knowledge about the ancient Egyptian domestic architecture are gained from paintings, inscriptions and models preserved in tombs. (CARL F. PETRY, 2008)

The earliest homes in Ancient Egypt were huts made of reeds built in pre dynastic and early dynastic periods in ancient Egypt. Reed huts, constructed predominantly from papyrus reeds and animal skins, were relatively small, enough for a small family and a hearth. These huts were likely supported by pole frames of bound reeds or wood and were easily demolished by heavy rain, wind or sandstorms. Later on the main materials used in ancient Egyptian domestic architecture were mud bricks. (Azad & Barua, 2017)

Mud brick and wood were the main construction materials for houses and palaces, regardless of period, location and social differences. Since the time of the Old Kingdom stone was used for temples and tombs. However, mud brick was the domestic main construction material used even for royal palaces, fortresses, and for the walls of temples and towns. Ancient mud bricks were a mixture of mud from the Nile and straw that then were shaped into a wooden mould to form bricks then were allowed to dry under the sun. The mud might have been plentiful in Ancient Egypt; however it was not particularly sturdy. Construction system used by ancient Egyptian was a reflection of the available materials. Mud construction was reserved for houses and other buildings of daily life; buildings that are supposed to last for only a generation. In the hot dry climate of Egypt mud houses were perfect. (Azad & Barua, 2017)

The Ancient Egyptian type and style of house differed according to the owner's social level. A mansion of the wealth or the nobles could be very huge up to 2500 square meters and consisted of thirty rooms or more, while the modest houses were about 200 square meters and consisted of six to twelve rooms. However the poorest lived in shelters of area that was less than 100 square meters and consisted of four rooms. Generally houses were made practical for the hot weather to be as comfortable as possible in the hot weather of Egypt. The basic Egyptian house was rectangular enclosure with placing the entrance door on the north façade if possible to face the prevailing wind. The composition of the house was divided into three main parts. After entrance door placed a garden with a water feature in the center with

some trees and shrubs planted around. Afterward there was a raised roofed area open at the front to provide shade and catch breezes, after which came apartments, walled and roofed for privacy and to keep out night time cold. (Ramadan, 2024)

Windows were small rectangular shape, they were put high up to keep out the sunlight and the sand, and they were often placed on the northern façade, moreover they were whitewashed to deflect the sun's heat. Glass was not used with windows, linen simply covered. The exterior and interior walls were white washed (white limestone plaster) that helped deflecting the high heat. Beams and columns were made of wood and tree trunks. (Ramadan, 2024) Ancient Egyptians used stairways to reach the house roof. There was a vent on the roof top to catch cool breezes. During the hot days of summer, the ancient Egyptians often used the roof for their daily activities such as cooking, eating and sleeping. The main façade facing the street had only the entrance opening, a wooden door that was locked from inside. Gateways were always made of stone even in the poor houses. A typical ancient Egyptian houses had a hearth, whether wealthy or poor ancient Egypt houses; in order to prepare food. The rooms of the houses were arranged around an inner courtyard or on either side of a corridor. (Jahy, 2023) Although almost all the Ancient Egyptian houses were diminished, Archaeologists have found scaled models of homes buried in the tombs of their owners. There were some houses constructed with stone for those who could afford to get stone from stone quarries, however having the same design and layout. (Azad & Barua, 2017)

For providing lighting in the interior Ancient Egyptians used lamps. The used type of lamps then was made from stone or pottery bowls filled with palm nut oil and flax or papyrus wick in the oil. The wealthy used a sprinkle of salt to reduce the smoke emissions. There were no running water in the wealthy houses, however they had bathrooms. They had shower rooms that consisted of a stone slab for the person to stand over and water was poured by servant. Water was praised by the ancient Egyptians therefore they made use of the waste water as it was drained using earthenware channel in the wall so as to be deposited into a large container, then that bowl was emptied by hand to be used for watering the garden. (Jahy, 2023)

## **5.2 Islamic Civilization in Egypt**

In 640 Egypt was profoundly changed, the Arab general Amr ibn al-As led the Arabian army across the Sinai desert into the Nile Valley, defeated the Byzantines at Cairo, marking the beginning of Islamic Egypt. (CARL F. PETRY, 2008).

### **5.2.1 Islamic City and Architecture**

Islamic architecture is the architecture products that resulted from social, cultural, political and religious phenomenon of Islam. Not only the religious buildings that are meant by the term, but also all types of buildings that have been influenced by Islamic culture. The new Egyptian capital reflected the cultural background of its Arabic founders. Islamic Architecture revised the urban fabric of the city as one unit. The building sites (both public structures and housing units) were organized, connected by pathways that varied in length and width depending on their importance and level of hierarchy. The city during the Islamic era had oriental fascinating streets; it had arcades, vaults, projections, domes, and minarets. Most of the streets were unpaved, narrow and irregular (broken paths). (Al-Ataabi & Hameed, 2020).

Islamic architecture respected the surroundings; for example shading was provided by the proximity of housing units and cantilevers were built into their external facades ensured that the pathways were shaded. Although the street pattern in old Cairo may look chaotic, it was an important feature that serves both function and aesthetics as follows, the scale of the street space gives a special character for the city of Cairo gives an intimate and personal feeling to the passersby. Moreover, this small scale of street space was a very effective solution to the problem of climatic control. As in hot arid climate like Egypt, the small lanes are mostly shaded during hot day which subsequently contributed in lowering the temperature in general and creating a better environment. (Al-Ataabi & Hameed, 2020).

The Mosque was considered as the only large community space within the neighborhood. The mosque served not only as a place of worship but also it fulfilled the functions of community centers of recent idea. The Islamic architect designed mixed use building; a school, a library and a center of learned discussion were in many cases in a common building together with a Shafakhana (hospital) and Yemekhana (restaurant). (Radwan, 2021).

### **5.2.2 Islamic Residential Architecture in Egypt**

The traditional Islamic-Arab houses were designed to respond to cultural, religious and traditional factors. The Islamic way of life has strict limits for the relation of man and woman and the built environment. As the house's public areas are the domain of men, while the family areas are the domain of women. As privacy was the most important element that affected traditional Islamic houses plan. Spaces were sorted as public or semi public or private spaces. The religious and cultural ideas also emphasised on neighbours' rights within Islamic communities that was strictly appearing in their designs. Climate also had widely affected the religious and cultural need for privacy, the houses of the hot climate areas applied environmental processors, such as Egypt. (CARL F. PETRY, 2008) It is worth mentioning that the halls and rooms in the traditional Islamic houses were categorized as living, dining and sleeping rooms, there were no rooms used as sleeping rooms, as is the case in modern houses. Between a grand residence and the rab' apartment unit were other levels of housing, of which very little has survived from the Ottoman period and nearly nothing from the other periods. These houses are described in their governmental documents. (CARL F. PETRY, 2008) The traditional Islamic residential house had one main open rectangular or square courtyard with a fountain in the middle to solve the problem of the dryness of the air. At the sides of the basin were flower-beds, vegetables and sometimes a tree. The rooms of the house surround this courtyard that provides daylighting and ventilations for the whole house. The courtyard always had a regular shape even when the land was irregular and there was strong correlation between the plan of the house and the land shape. (Doris Behrens-Abouseif, 1992) The size and the number of the courtyard varied according to the available

space and the house's size. But usually there were two main courts one for the public area (men's / visitors' area) and the other for the private area (women's area) besides the entrance court. (Al-Ataabi & Hameed, 2020).

The main entrance (the majaz) was curved L shaped to maintain privacy to the households and it usually opens onto the courtyard. The ground floor room was dedicated to the daily activities while the upper floors were dedicated for living and sleeping of the family members. (Al-Ataabi & Hameed, 2020) The main construction material was bricks, besides wood that was used in ceiling construction and gypsum that was used for decorations. (Dian Nafi, 2023) For construction materials, red bricks were the most common building material used; they were used in building columns, bearing walls and in the construction of vaults and domes. Wood and stone were used but not as much as bricks. Brick walls were covered by white plasterboards. And marble was widely used for the flooring and skirting. (Doris Behrens-Abouseif, 1992).

Some houses had central living room called qa'ah which was high ceiling space covered by a skylight (a shukhshakhah) (wooden lantern on the top). The shukhshakhah was provided with openings to allow the hot air out; it had squared shape. It was flat on the top exposed to the sun to help the upper layer of air to be heated. (Al-Ataabi & Hameed, 2020) The malqaf (wind catcher) was used to achieve thermal comfort. It is a shaft raised higher than the building roof top with an opening that traps the cool air to be led it down through it into the interior spaces. The malqaf's rooftop had a sloped at acute angle with wooden cover so as to face the northern or north-western prevailing wind so the air would be captured and let into the interior spaces. Another element, the salsabil, was introduced to help increasing the air's humidity while coming from the malqaf. It is a decorated marble plate that was provided with a source of water. (Doris Behrens-Abouseif, 1992) Another element was used in some houses was the mashrabiyyah; a wooden lattice covering the building openings. There was a small niche extended out from the mashrabiyyah where drinking water bottles were put. (CARL F. PETRY, 2008).

## 6. Results

This section demonstrate the assessment of the residential buildings during both era as per the assessment criteria developed in section 4.

### 6.1 Assessment of ancient Egyptian residential architecture

#### A. Environmental Health

##### A.1 Sustainable site and ecology

- a) The selection of the houses' sites during the Ancient Egyptian periods was dependent on the Nile route; to avoid its annual flood. They headed for deserted area or elevated ground to live. However, they did not go so far from the Nile that considered as their source of food, water, profession and building materials.
- b) Mud was the used building material for domestic architecture regardless of the period, location and social differences. The processes of the construction of a sun dried mud building were carried out by ordinary people with no particular skills, machinery was needed.
- c) They carefully chose the location of certain features, for example ovens or hearth; they placed it on the southern side of the house. Orientation had affected ventilation and daylighting, which in turn affected general house conditions, such as temperature.
- d) The Ancient Egyptian admired the nature and natural fauna and they respected them. They built their residence around existing trees and integrated with them.
- e) The oldest aesthetically designed gardens come from Egypt; they used building exterior and landscape and designed Garden Houses with a reasonable building footprint relative to the garden area. Moreover, they respected the topographical conditions and overcome them by using sand for levelling.
- f) Minimizing the pollution during construction as back then, there were not any sort of machinery; they used domesticated animals for transportation.
- g) The Ancient Egyptian had area reserved for his profession at his residence. Egypt was considered a village society; they were scattered around a relatively small areas. They had the concept of the neighbourhood, so they did not have to travel large distances for daily needs and social life.
- h) They washed their houses with light colors especially white and used shaded areas minimizing the heat island effect.
- i) The fact that they used building material of organic nature helped the prevention of any pollution during construction or during the building lifetime; they were nontoxic materials.

##### A.2 Energy Efficiency

- a) Ancient Egyptian used the sun to dry their mud bricks; so the used materials had very low embodied energy.
- b) They did not use any non renewable resources of energy in construction regarding it was not available now then.
- c) Windows were small rectangular shape; they were put high up to keep out the sunlight and the sand achieving proper thermal comfort, however letting minimum daylighting.

##### A.3 Water Efficiency

- a) Water was precious in Egypt; the waste water was drained and used for watering the garden. They had not any running water fixtures; they used the shadoof and transferred water in pots by hand. However, they had not proper waste management.

##### A.4 Materials and resources

- a) It is clear that Ancient Egyptians used regional materials which were fabricated onsite.

b) All the materials used by them could be repeatedly recycled into other features; they were renewable and durable materials. As well as its low cost and energy efficiency. However, there is no evidence that they used recycled or salvaged materials.

c) Regarding the infrequent rain in Egypt, the life span of mud was adequate for residential housing. And through applying regular maintenance, it can last for a relatively long time. Mud bricks proved through history durability and cultural applicability.

#### **A.5 Indoor Environmental quality**

a) The Ancient Egyptians used passive heating and cooling methods in the landscape like opening southern exposure, shading in summer; by plants or overhangs.

b) They placed their opening on the northern facade to allow the nice breath to pass through the house and used the roof that contained a vent for catching cool breezes. Besides, they used courtyard to provide privacy and to generate air movement convection to provide adequate climate. They placed a raised roofed area open at the front of the house to provide shaded area and catch breeze. They used water features in their gardens and courtyards and in palaces the used water features in the interior as well.

c) Windows were small rectangular shape; they were put high up to keep out the sunlight and the sand achieving proper thermal comfort, however letting minimum daylighting may had caused visual discomfort.

d) Building multiple storey houses helped minimizing the interior temperature and minimizing the building footprint and affected ventilation.

e) Using thick walls to decrease the heat gain from the hot Egyptian weather and sometimes wealthy nobles used stone that had high thermal capacity to build their mansions. Besides, this could help achieving proper acoustic comfort.

f) The use of natural environmentally friendly non toxic materials.

g) As mentioned ancient Egyptian used proper ventilation procedure providing effective the indoor air quality, however they used lighting fixtures that caused smoke release in the interior.

#### **A.6 Post Building use**

##### **B. Economic Vitality**

a) Ancient Egyptians had minimum resources; as they would not want to infertile a lot of land to build their houses, and many could not afford stone structure. They probably had proper construction management regarding the economy of resources.

b) The selection of durable materials with low maintenance costs, besides the use of locally available materials with low life cycle pricing that reduces transport, annual operation and maintenance costs.

c) Minimizing annual operation and maintenance through depending on natural energy sources to provide natural ventilation, daylighting and thermal comfort.

d) There is no evidence that the building used salvaged or recycled building materials.

##### **C. Social Equity**

###### **C.1 Social and functional diversity**

a) Ancient Egyptians used mixed use buildings. Even within their houses. The Ancient Egyptian houses were considered as a self sufficient unit.

b) The presence of open spaces within the building site for occupants which are the open courtyards, for occupants use with presence of water feature and greenery.

c) The good ratio of the building footprint to the open areas of the house.

d) Every ancient Egyptian village or settlement had its own temple and protective gods. They had their worshipping places near their houses. The wealthy had their own chapel within their mansions.

###### **C.2 Community services**

a) The Temple was considered as a community centre for them where they met, socialize and had their events. The temple had its own gardens and open spaces for their gathering. Since the Old Kingdom and later on houses were arranged as clusters surrounding an open spaces or gardens.

b) The Ancient Egyptians had elementary schools for teaching writing, reading and arithmetic science. After which only few attended schools to become a scribe or priest or doctor or lawyers. However, almost everyone learned how to read, write and perform mathematical processes.

c) Although Ancient Egyptians pioneered in medicine, there is no evidence that they had health care facilities. However, the basic knowledge about health care was quite known by most of them.

###### **C.3 Neighborhood rights**

a) Besides having courtyards to achieve privacy, ancient Egyptians built wall around their houses to achieve privacy and to protect their residence from wild animals and intruders.

b) The Ancient Egyptians were very active and productive. Everyone had his own role and profession. Most of them worked as peasants and craftsmen. There were government employee, priests, scribes and builders and artists.. After the harvest, the peasants worked in building the royals tombs. Ancient Egyptians never were unemployed.

The Egyptian architectural heritage had proved to be sustainable in many ways, even according to the modern concept of sustainability.

## **6.2 Assessment of Islamic Residential buildings**

### **A. Environmental Health**

#### **A.1 Sustainable site and ecology**

- a) The construction of the building almost did not cause any negative environmental impact on the site and its surroundings as the used construction materials were locally available natural materials, such as wood and stone. Due to the lack of technology then; there was no use of any heavy machinery that cause pollution or materials that cause the generation of dust and pollutants.
- b) Buildings are oriented towards the northwest direction to be facing the prevailing wind and the suitable orientation of most of the openings such as maqa'ad openings that faces the north.
- c) Energy conscious site planning by using passive heating and cooling methods in the landscape by providing water features and greenery. In addition to the protection from being exposed to the sun's rays by limiting the number of openings as possible on the south facade and these openings are placed on higher levels, besides the usage of mashrabiyyahs to minimize the sun rays entering the house and provide ventilation.
- d) Minimizing the heat islands effect through use of the inner courtyard that caused the regulation of temperatures and protection against external elements in addition to the use of light natural colour of the materials.
- e) No plants or landscape elements were placed for shading purposes.
- f) The use of fountains and trees in the courtyard and the private garden provide raising humidity levels.

### **A.2 Energy Efficiency**

- a) Using of passive evaporative cooling method as the buildings applied the use of natural and renewable energy resources of energy by using water vapour cooling in salsabil that causes lower humidity levels and temperatures and using natural lighting.
- b) The building's openings design utilizes natural daylighting.
- c) Using construction materials of low thermal conductivity, that are derived locally such as brick and stone, that provide thermal insulation, besides using of mashrabiyyahs over the building openings. Moreover, insulation of indoor spaces with using other spaces such as iwans.

### **A.3 Water Efficiency**

- a) The use of Sanitary fixtures.
- b) No water recycling solutions were used.

### **A.4 Materials and resources**

- a) The use of regionally procured materials; the building's construction materials used are locally available building materials.
- b) The use of readily renewable materials such as stone, bricks and wood which are natural construction materials, besides being nontoxic poisonous materials.
- c) Using materials with relatively low thermal conductivity such as stone in the ground floor walls to beat water and humidity while bricks were used in the upper floors to beat sun rays.
- d) The use materials that have the ability to resist erosion and require minimal maintenance such as stone and wood. These materials are easy to be operated and controlled.
- e) There is no evidence that the building used salvaged or recycled building materials.

### **A.5 Indoor Environmental quality**

- a) Achieving climatic control by applying inward-oriented design of the building and designing ventilation and cooling system by using passive techniques to ensure appropriate ventilation of the indoor spaces through using different pressure zones by applying the design of the small shaded and paved courtyard and the larger uncovered planted courtyard, besides using shukhshakhah to let hot air escape as it rises upwards and malqafs to capture cool breezes that replace the escaped hot air. As well as the use of mashrabiyyahs that controls the air flow through it to help increasing the air current humidity and reducing its temperature, in addition to the orientation of spaces towards the north.
- b) Using construction materials with low thermal conductivity to minimize the transfer of external heat into the house interior that help reducing internal temperature resulting in achieving thermal comfort.
- c) Regulation of air humidity levels through water vapour techniques by applying the salsabils.
- d) The use of natural environmentally friendly non toxic materials such as stone tile and marble flooring, Moreover, furniture is made of wood and stone which are environmentally friendly materials by using renewable natural energy sources.
- e) The quality of indoor lighting to achieve visual comfort by utilizing the courtyard that let daylighting enter into indoor spaces, besides using architectural elements such as mashrabiyyahs and light wells that reduce direct sun light into the space and allow a appropriate amount of light.
- f) Achieving acoustic comfort through noise level control through placing of most used indoor area like the large and the small halls far from the streets, besides applying the inward-oriented design and reducing noise transmission from the outside through using thick stone walls.

### **A.6 Post Building use**

Most of the residential buildings from the Islamic era in Egypt is still present and usable. They were used as a residence for long time by many owners then they both was adapted to new uses by the Egyptian Ministry of Awqaf.

## **B. Economic Vitality**

- a) The selection of durable materials with low maintenance costs, besides the use of locally available materials with low life cycle pricing that reduces transport, annual operation and maintenance costs.
- b) Minimizing annual operation and maintenance by utilizing natural energy resources by using natural ventilation, daylighting and thermal comfort.
- c) There is no evidence that the building used salvaged or recycled building materials.

## **C. Social Equity**

### **C.1 Social and functional diversity**

- a) The presence of open spaces within the building site for occupants which are the open courtyards, for occupants use with presence of water feature and greenery, besides providing privacy of these spaces.
- b) The appropriate ratio of the building footprint to the open areas of the house.
- c) The proximity to worship places as the Islamic cities had several mosques that were designed to be through a walkable distance for users.

### **C.2 Community services**

- a) Mosques played a vital role as a community centers where residents had gathered socialize and celebrate events.
- b) The design of Islamic cities was made as each district is a vital area with all daily basic needs lie within reasonable walking distance as well as educational facilities.

### **C.3 Neighborhood rights**

- a) Ensuring privacy by applying the design of bent entrances, separating public reception and private spaces, using some architectural elements such as mashrabiyyahs and the inward-oriented building design, besides limiting the number of openings on external facades and placing them on higher levels.
- b) The previous mentioned design solutions assured the achieving privacy for the building without compromising the neighbour privacy issues. Moreover the Islamic religious confirmed the rights of the neighbours where it was not allowed for the buildings to be higher than the buildings next to it so as not to violate its privacy.

## **7. Conclusions**

Heritage is considered as a source of creativity, being the product presenting the experience of the community members and their way in dealing with the conditions of their lives through different times. The features and characteristics of the building differ from one era to another according to the change of the public image of the society and are affected by society features such as political, social, economic and cultural features. Despite the increased attention towards the use of the term "sustainability", the societies appear to not achieving sustainability, environmental degradation, overconsumption, climate change and indefinite economic growth are proof of the dysfunction of applying sustainable development. Traditional Egyptian vernacular architecture provides many ideas that help people living in hot arid regions to adapt to these climatic conditions. Buildings made out of local available material fulfill the natural images of sustainability as seen in local vernacular Architecture and inspired from Egyptian Architecture through different civilizations. Vernacular forms inspired from heritage give several forms of beauty due to the harmony in their forms. The industrial revolution and the increased movement of materials caused severe changes in the methods of construction and the building materials causing a significant move away from buildings constructed using vernacular materials. Ancient Egyptian architecture dealt with the environment and integrated with it. The ancient Egyptians tried to overcome the environment constrains and work along with it. The design of the Islamic houses retained an architecture that focused on both the hot climate and basic religious needs. For instance applying the concept of the courtyard and the utilizing of architectural elements such as malqafs and mashrabiyyahs provided environmental solutions for the climatic conditions and satisfied the religion needs that suited the Muslim families such as privacy. These buildings encompassed most of the rules of sustainability including its three aspects with its modern concept.

The research identifies several key sustainability principles evident in Egyptian architectural heritage:

1. Climate adaptation
2. Use of local and natural materials
3. Passive cooling and heating strategies
4. Water conservation techniques
5. Social and cultural considerations in design

## **8. Recommendations**

For practical application in the construction industry, it is a must to reconsider building's architectural design stages (from design concept formulation and site selection, to detailed building design, choice of construction materials and selection of environmental solutions) and apply sustainable architecture principles. The adoption of International architectural models and trends should be after deep thought and serious consideration whether they suit our society or not. Consider using traditional historic architectural design solutions that are suitable to local environmental conditions to provide thermal comfort, natural lighting and ventilation and to successfully design environmentally friend houses and resolve current environmental issues.

As for Architecture Education, there must be initiative for raising environmental awareness among individuals and institutions and developing education curricula towards that aim. Moreover, introducing heritage architecture and sustainable architecture concepts and solutions it embodies into the architectural education system.

To further advance sustainable architecture in Egypt, future research could focus on: 1) Quantitative analysis of energy efficiency in historical buildings compared to modern structures. 2) Development of innovative materials that combine traditional properties with modern performance standards. 3) Integration of smart technologies with

traditional sustainable design principles. 4) Case studies of successful modern implementations of historical sustainable practices in Egypt and other similar climates. 5) Exploration of urban planning strategies that incorporate sustainable architectural principles at a city-wide scale. By continuing to explore and apply the lessons from Egypt's rich architectural history, the country can work towards a more sustainable and environmentally conscious built environment for the future.

### Acknowledgements

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

### Conflict of Interests

The Authors declare that there is no conflict of interest.

### References

- Akolade, S., & Alli, O. (2018). ENVIRONMENTAL SUSTAINABLE BUILDING DESIGN AND CONSTRUCTION. *International Journal of Energy and Environmental Engineering*, 4, 20–24.
- Al-Ataabi, M., & Hameed, T. (2020). Architecture and urban of the Islamic Arabic city “Study in unlimited their properties.” *IOP Conference Series: Materials Science and Engineering*, 737, 012243. <https://doi.org/10.1088/1757-899X/737/1/012243>
- Allen, T. D. (2008). *The Ancient Egyptian Family Kinship and Social Structure* (First, Vol. 1). Routledge. <https://doi.org/10.4324/9780203890226>
- Afara, Ahmad, Mustafa Aziz Amen, Maysan El Ayoubi, Dana Ramadhan, and Jalal Alani. 2024. “Arguing Faux Biophilia Concepts in F&B Interior Design: A Case Study Applied in Duhok City.” *Civil Engineering and Architecture* 12(2):1091–1103. doi:10.13189/cea.2024.120231.
- Amen, Mustafa Aziz, Ahmad Afara, and Salar Salah Muhy-Al-din. 2024. “The Persuasibility of Globe Thermometer in Predicting Indoor Thermal Comfort Using Non-Standard Globe Diameter: Row Houses of Semi-Arid Climates as Case Studies.” *Civil Engineering and Architecture* 12(1):425–35. doi:10.13189/cea.2024.120132.
- Arafat, M. Y., Faggal, A. A., Khodeir, L., & Refaat, T. (2023). Customizing the green pyramid rating system for assessing university buildings’ sustainability: A stakeholder-involved weighting approach. *Alexandria Engineering Journal*, 82, 446–458. <https://doi.org/https://doi.org/10.1016/j.aej.2023.10.013>
- Azad, D., & Barua, A. (2017). A Case Studies of Ancient Egyptian Architecture. *International Journal of Engineering and Applied Sciences (IJEAS)*, 4, 35–40.
- CARL F. PETRY (Ed.). (2008). *THE CAMBRIDGE HISTORY OF EGYPT VOLUME I: Vol. I*. Cambridge University Press.
- Clay, K., Severnini, E., & Sun, X. (2023). Does LEED certification save energy? Evidence from retrofitted federal buildings. *Journal of Environmental Economics and Management*, 121, 102866. <https://doi.org/https://doi.org/10.1016/j.jeem.2023.102866>
- Dabija, A. M. (2020). Sustainability from theory to practice: An architectural analysis of some principles of sustainability in buildings. *IOP Conference Series: Materials Science and Engineering*, 960(3). <https://doi.org/10.1088/1757-899X/960/3/032005>
- Dian Nafi. (2023). *Islamic Architecture*. Hasfa , 2023.
- Doris Behrens-Abouseif. (1992). *Islamic Architecture in Cairo: An Introduction* (illustrated, revised). BRILL, 1992.
- Hafez, F. S., Sa’di, B., Safa-Gamal, M., Taufiq-Yap, Y. H., Alrifay, M., Seyedmahmoudian, M., Stojcevski, A., Horan, B., & Mekhilef, S. (2023). Energy Efficiency in Sustainable Buildings: A Systematic Review with Taxonomy, Challenges, Motivations, Methodological Aspects, Recommendations, and Pathways for Future Research. *Energy Strategy Reviews*, 45, 101013. <https://doi.org/https://doi.org/10.1016/j.esr.2022.101013>
- Hamedani, A., & Huber, F. (2012). *A comparative study of “DGNB”, “LEED” and “BREEAM” certificate system in urban sustainability*. <https://doi.org/10.13140/2.1.3177.0568>
- Hickmann, T., Biermann, F., Spinazzola, M., Ballard, C., Bogers, M., Forestier, O., Kalfagianni, A., Kim, R. E., Montesano, F. S., & Peek, T. (2023). Success factors of global goal-setting for sustainable development: Learning from the Millennium Development Goals. *Sustainable Development*, 31(3), 1214–1225.
- Islam 李伊凡, Md. Z., & SHUWEI, W. (2023). Environmental Sustainability: A Major Component of Sustainable Development. *International Journal of Environmental, Sustainability, and Social Science*, 4, 620–627. <https://doi.org/10.38142/ijess.v4i2.296>
- Jahy, K. (2023). Ancient Egyptian Houses during the Period of the Pharaohs Fayha’a Kadhim Jahy. *Journal of Namibian Studies*, 33, 2033–2041.
- Kadry, M. K., & Husam , H. R. (2024). EVALUATING POPULATION REDISTRIBUTION IN EGYPT: INSIGHTS FROM RESIDENT AND NON-RESIDENT PERSPECTIVES ON NEW URBAN COMMUNITIES. *New Design Ideas*, 186-204. doi: <https://doi.org/10.62476/ndisi186>
- Kadry, M.K., Husain, H.R. (2024). Evaluating population redistribution in Egypt: Insights from resident and nonresident perspectives on new urban communities. *New Design Ideas*, 8(Special Issue), 186-204 <https://doi.org/10.62476/ndisi186>

- Liu, T., Chen, L., Yang, M., Sandanayake, M., Miao, P., Shi, Y., & Yap, P. S. (2022). Sustainability Considerations of Green Buildings: A Detailed Overview on Current Advancements and Future Considerations. *Sustainability*, 14, 14393. <https://doi.org/10.3390/su142114393>
- Poorisat, T., Aigwi, I. E., Doan, D. T., & GhaffarianHoseini, A. (2024). Unlocking the potentials of sustainable building designs and practices: A Systematic Review. *Building and Environment*, 266, 112069. <https://doi.org/https://doi.org/10.1016/j.buildenv.2024.112069>
- Purvis, B., Mao, Y., & Robinson, D. (2019). Three pillars of sustainability: in search of conceptual origins. *Sustainability Science*, 14(3), 681–695. <https://doi.org/10.1007/s11625-018-0627-5>
- Radwan, A. (2021). دور المسجد كفراغ عام في المدينة الإسلامية، دراسة تحليلية لعمارة وعمران بعض النماذج المعاصرة. *مجلة العمارة والفنون والعلوم الإنسانية*, 0(0), 0–0. <https://doi.org/10.21608/mjaf.2020.35199.1712>
- Ramadan, G. (2024). MJAF\_Volume 9\_Issue 44\_Pages 38-61 (Author, Trans.). *MJAF*, 0(44), 38–61. <https://doi.org/10.21608/MJAF.2022.124775.2674>
- Refaat, H. (2024). THE RELIGIOUS GUIDANCE CONCEPT IN ANCIENT EGYPT MOHAMMED YEHIA ZAKARIA RESEARCHER, FACULTY OF TOURISM AND HOTELS, LUXOR UNIVERSITY, EGYPT REHAB MAHMOUD EL-SHARNOUBY FACULTY OF TOURISM AND HOTELS, MANSOURA UNIVERSITY. In *International Journal of Tourism and Hospitality Management* (Vol. 7, Issue 1).
- Wang, K., & Ke, Y. (2024). Social sustainability of communities: A systematic literature review. *Sustainable Production and Consumption*, 47, 585–597. <https://doi.org/https://doi.org/10.1016/j.spc.2024.04.031>