

The impact of the evolution of building design and structure on achieving sustainable development in interior architecture

أثر تطور تصميم المباني وهيكلها على تحقيق التنمية المستدامة في العمارة الداخلية

Dalia Mohamed mekky

Lecturer at the faculty of Arts and design decor - interior architecture
department pharos University of Alexandria

ABSTRACT:

Sustainable interior design could be a complex and advancing field that requires an approach to design. It includes an understanding of the effect of plan on the environment, as well as on human. It also requires designers that has knowledge about local materials, building structures and energy-efficient. One of the basic aspects of the designer is the utilize of sustainable materials. such as bamboo, mud and reused metal, plastic and glass .The arches, domes or geodesic domes, have great influence on interior design, structures material and designing since time immemorial. These interesting structures offer a wide assortment of focal points and have advanced over time to suit needs and styles. In this research, we'll investigate where domes came from, who made them all through history, why they're still a prevalent choice nowadays, and how they've advanced over a long time.

Domes and Sustainable Engineering in modern design have adapt to current needs and challenges, including sustainability and energy productivity goals which can be presented in: Geodesic arches: geodesic arches are solid, lightweight structures based on polyhedrons. These domes are simple to construct and require less material than other sorts of arches, making them an energy effective and sustainable option. Compacted earth arches: These arches, moreover known as "mud arches," are made of soil compacted into sacks and heaped up in an arch shape. They are an ecological and low-cost development choice, particularly in locales with rare assets or in provincial areas.

• **keywords:**

Corbelled Domes- Hassan Fathy - Natural Lighting -Local Materials - The corbelling theory Ancient Green Building - Abu Sair House.

1. Introduction

Environmental design is a process related to solving environmental issues, and it is the science from which the integration between design and the environment is inferred. This specialty has risen as a common strength since the early fifties. In spite of the fact that numerous recommendations and considers independently address the concepts of environmental and sustainable plan, they clarify the shared relationship between environmental plan, ecological and organic design, and interior architecture which achieves Its objectives are to explore nature to attain the greatest advantage.

The design and calculations are done by creating the form of the building's outside mass and its flat and vertical inner spaces and shaping the building's even and vertical levels, their introduction and area concerning the heading of the sun and the movement of the wind. Insulation levels in building units to decrease heat gain and misfortune, and reduce the profundity of the building arrange to supply greatest characteristic light.

2. Research Problem:

The lack of knowledge regarding the role played by the tremendous development in he design of buildings and their structural structures has a strong impact on achieving sustainable development through the application of sustainable design strategies and helps in reducing these negative impacts on the built environment.

3. Research Objectives:

Finding solutions to the items related to the research problem, through:

- Creating a theoretical foundation for sustainability, sustainable interior and sustainability strategies through the built designs and structural architecture that have evolved and has affected the realization of sustainable development.
- Energy conservation
- Reducing the consumption of natural energy resources...
- Restoring the connection between humans and the environment and benefiting from nature

4. Sustainable Development

Development that takes into account the social and environmental dimensions as well as the economic dimensions of making good use of available resources to meet individuals' needs while retaining the right of future generations. The world faces the gravity of environmental degradation that must be overcome while not abandoning the needs of economic development as well as equality and justice.

4.1. Sustainable Development Goals in Accordance with The United Nations Definition

It is a plan for a better and more sustainable future for all. These goals address the global challenges we face, including those related to poverty, inequality, climate, environmental degradation, prosperity, peace and justice in addition to the coherence of the goals to ensure that no one is left behind. It is important to achieve each of the goals by 2030. DEPEND on any particular target underneath to discover out a more full breakdown of each challenge.

4.2. How to Achieve Sustainable Development Goals in Accordance with Egypt's Agenda 2030

The 2030 Agenda for Sustainable Development is based on the principle of "leaving no one or a place behind". This means that sustainable development must include all groups and places without any distinction. This requires a great effort especially in large countries in terms of population and area such as the Arab Republic of Egypt. Thus, the Egyptian State is paying increased attention to the process of localizing the sustainable development goals because they have an impact on the achievement of inclusive and sustainable growth and balanced regional development as one of the most fundamental pillars of the National Sustainable Development Strategy: Egypt's Vision 2030. In order for local authorities to be able to participate effectively in the process of localizing the Sustainable Development Goals (SDGs), it was necessary to have data identifying the position of each governorate in SDG indicators and indicator targets for each governorate in 2030 based on the current situation and ambition to reach SDG targets at the strong level.

4.3. Frederickspardi's Analysis of Sustainable Development Mechanisms in The Arab Republic of Egypt Through the Following Axes

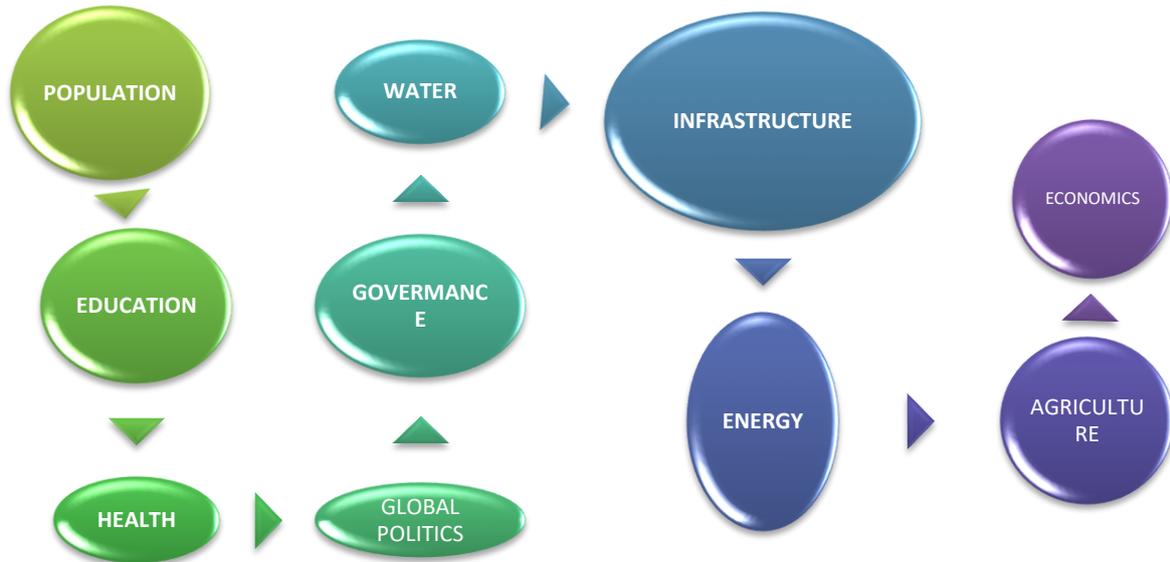


Fig.1
Shows Frederickspardi's Analysis Of Sustainable Development Mechanisms In The Arab Republic Of Egypt

5. The Combination between Design concepts and the surrounding Environment in the Past and Present

IN recent times, there has been a growing interest in the environment among people. New concepts are attempting to integrate older and contemporary architecture with the natural surroundings. The building of the dome has great significance in the development of architecture It made it possible for vast open spaces without requiring columns or pillars for reinforcement. The inclusion of domes in architecture is now essential, showcasing the abilities and originality of architects and builders.

6 .Evolution of Architectural Design Elements and Structures

Architectural design elements have evolved over the ages. Before the existence of domes, there were rectangular buildings supported by columns. Most historical buildings, such as temples, were based on roofs supported by columns. Columns are distinguished by their great ability to support roofs and protect them from collapsing. However, the need for a large number of them results in Limited internal spaces compared to what does allow, so new elements appeared as a result of the development of the design and shape of the dome and the need to develop its use within different spaces.

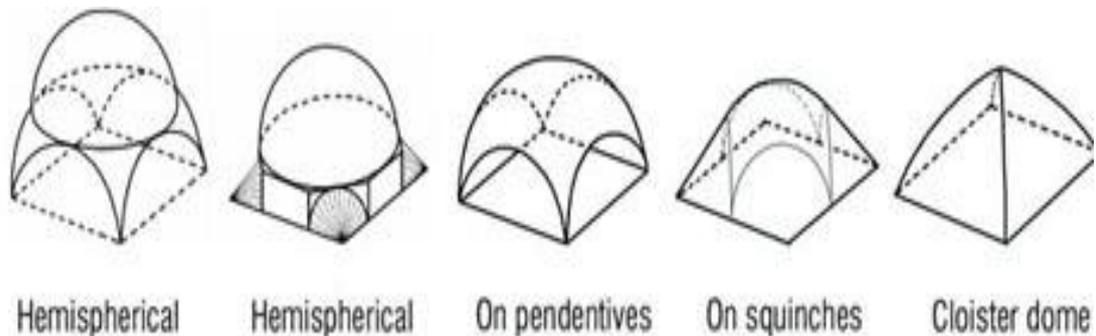


Fig.2
Shows Diversity of domes design between hemispherical, segmental and pointed shape

6.1 -The emergence of domes, vaults and arches that marked the beginning of a new era in architectural design.

Types of domes that were built in prehistoric times:

Domes have a long architectural lineage extending back to prehistory, and have been constructed of clay, stone, wood, brick, concrete, metal, glass and plastic over the centuries.

Domes were found from early Mesopotamia and then found in traces of Persian, Hellenistic, Roman and Chinese architecture in the ancient world. The first to be discovered may be four small dwellings made of mammoth tusks and bones, Ukraine, in 1965.

These early examples of domes demonstrate the diverse range of materials and construction techniques that have been used throughout history.

7. Corbelled Domes

In the Near East (Turkey, Syria, Iraq, and Iran), corbelled domes without a mound composed of earthen materials (adobe bricks and mud mortar) are commonplace. They are the result of a long-standing cultural tradition. These kinds of buildings seem to be the product of self-building processes as well as the representation of significant constructive knowledge that has been passed down through time, connected to the soil, and ingrained in the national cultures of each nation. Similar to several other relics that embody small-scale productive cultures while displaying ancient knowledge these structures provides a legacy that necessitates examination to offer direction for preservation and improvement.

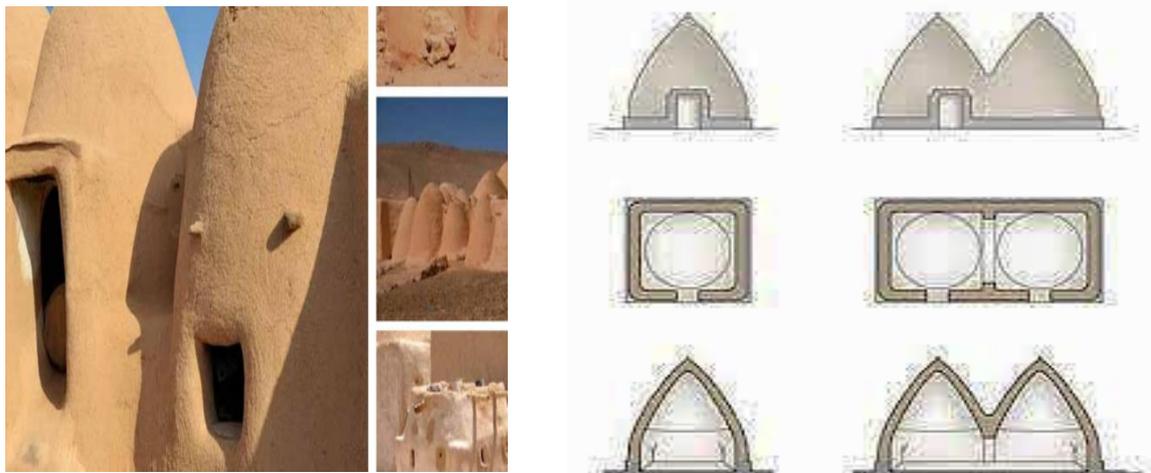


Fig 3 Show the important typologies of corbelled domes which has been distinguished: by the old hypogean developments

7.1. The corbelling theory

The corbelling theory is used for corbelled domes without a mound and corbelled arches. The theory is applied to Catalane domes in which are roughly represented as cones due to their nearly straight profiles. In this instance, the linear profile assumption allows for a clear understanding of the relationship between thickness, span, and height through the use of straightforward equations that create equilibrium on overturning forces.

8. Early implementation of MANSORY blocks in SIWA.

The construction of the ancient 12th century fortress Shari in Siwa, desert oasis in western Egypt. A distinctive feature of this architecture is the use of salt blocks from nearby salt lakes. This is a masonry block made with plenty of clay mortar that contains a lot of salt. This technique still exists in modern times and is used by older masons in some new buildings. Such special technology is the result of human ability and skill in utilizing local environmental resources, and at the same time made it possible to realize buildings that are especially comfortable even in the harsh climatic conditions of the wrinkles.

8.1. Ancient Green Building Technique Taking Hold in SOUTH OF EYGPT

The Nubian vault style was revived by Egyptian architect Hassan Fathy after he rediscovered the technique in the Nubian village of Abu al-Richeh. . Fathy has been interested in housing the poor for many years. His solution was to use local materials to build low-cost housing.

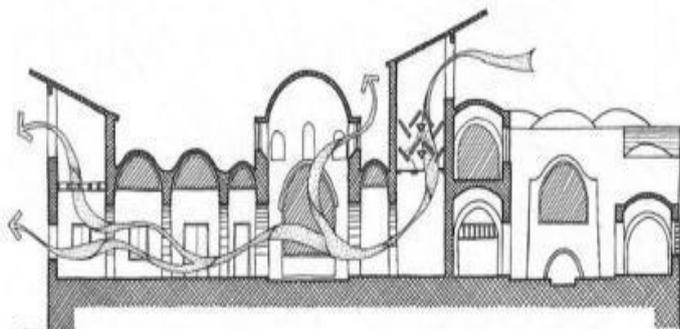


Fig 4 show that Hassan Fathy applied natural passive cooling and vernacular architecture in his designs.



Fig 5 show thick walls built of local material to achieve thermal comfort in interior spaces

8.2. Buddhist center design a Regenerative Home inspired by Hassan fathy:

Buddhist design inspired from Egyptian architect (Hassan Fathy. father of sustainable **architecture in the Middle East**) Buddhist team **strive** to design **Attractive** buildings that **reduces** material consumption and **is based** on **old** roofing **structures known as Nubian vaults which** stay cool in summer and warm in winter and are significantly more affordable than their timber counterparts.

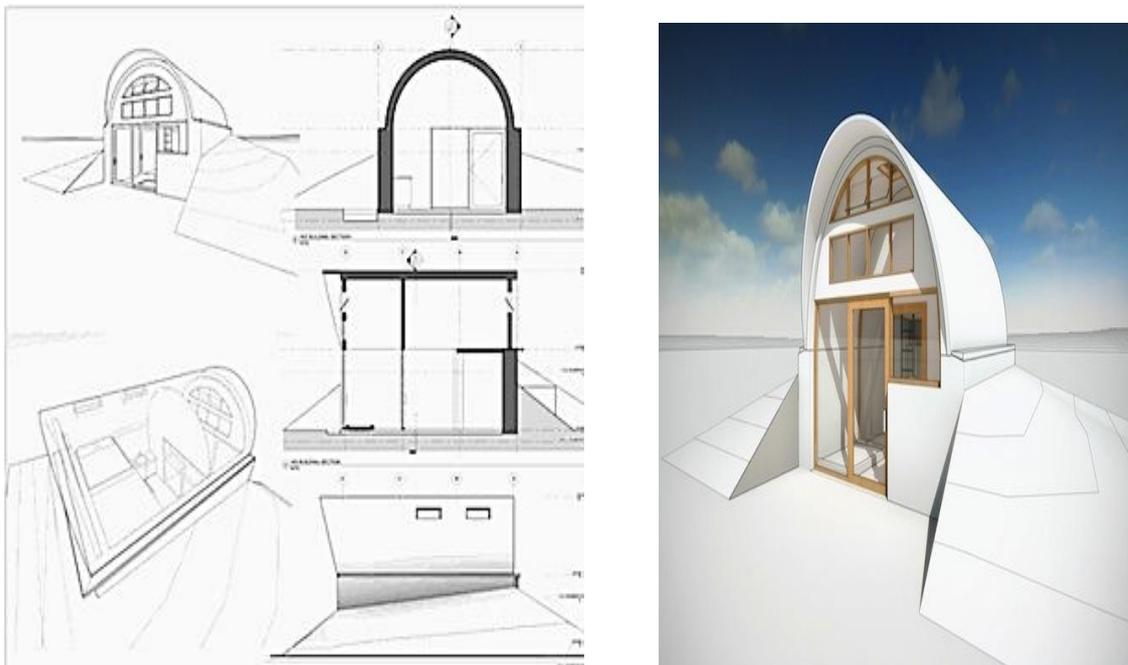


Fig6: shows the Nubian vaults roofing structure in Buddhist center design a Regenerative Home

8.3 Using an ancient Nubian vault as a modern solution for rural Tanzania

The Nubian vault development starts from Nubia a locale place along the Nile River that was home to one of the earliest civilizations in ancient Africans. The Nubian vault system is low-cost as the majority of the construction which depends on local materials such as sunbaked bricks made from local soil.

The aim of this project is to spread modern interpretations of ancient techniques across Africa. After considering existing building systems in rural Tanzania. The

design team use existing construction methods based on clay and branches although the deforestation has created a shortage of wood and brick burning is costly and unsustainable for the environment.

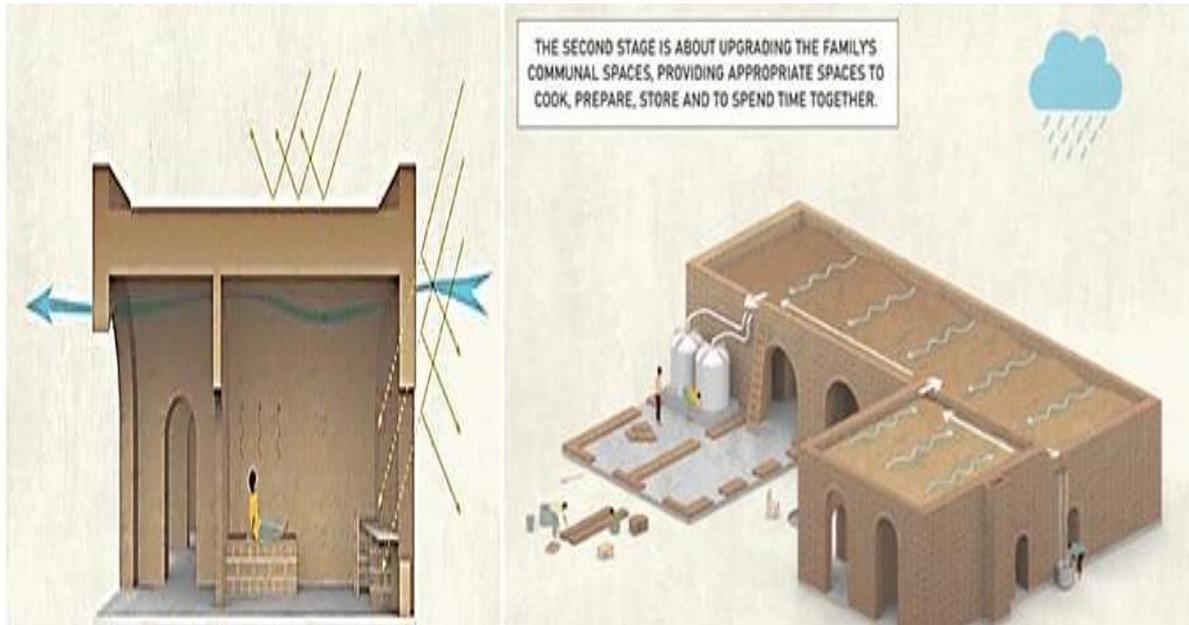


Fig7 shows roofing structure lined by rain collecting pipes and thick wall allow thermal insulation and cross natural ventilation

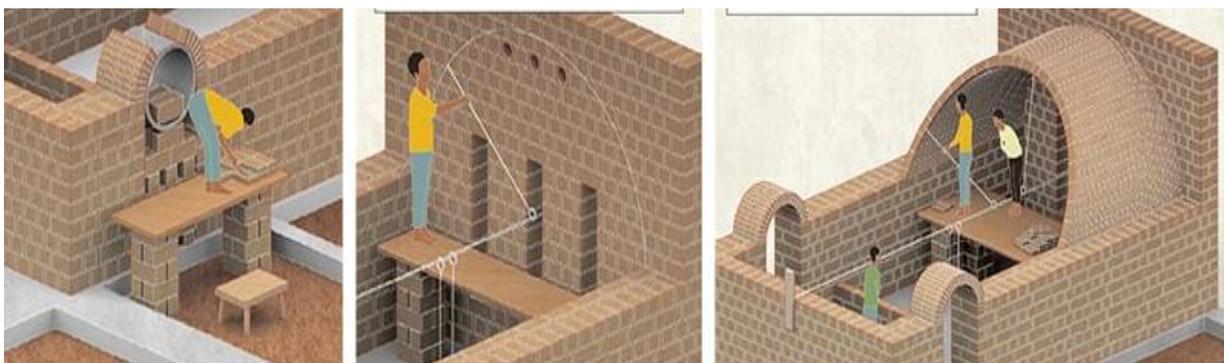


Fig8 . shows the Nubian vaults roofing structure in as a modern solution for rural Tanzania

8.4. Abu Sair House Applying Hassan Fathy Solutions

Abu Sair House, designed by Egyptian architect Tariq La bib, is located in the Al Geez governorate. The house consists of a residential space and a personal office for the architect in the village of Abu Sir in the Egyptian Giza Governorate. The house is presenting a unique experimental model that attempts to preserve the identity in a modern spirit and reduces energy consumption. The architect was inspired by many sources, such as the metaphor of the traditional Arab house, the covering of Egyptian vaults and the canopies of tents. He also used various available building materials such as red clay bricks, cement bricks, and Siwa salt bricks, in addition to using many environmental treatments such as double walls and the use of Thermal insulation with the use of specially designed and hidden mechanical air conditioning units



Fig9
Shows ceiling design inspired from Egyptian
basements



Fig10
Shows The usage OF various building
materials such as red child bricks, cement
bricks and siwa salt bricks

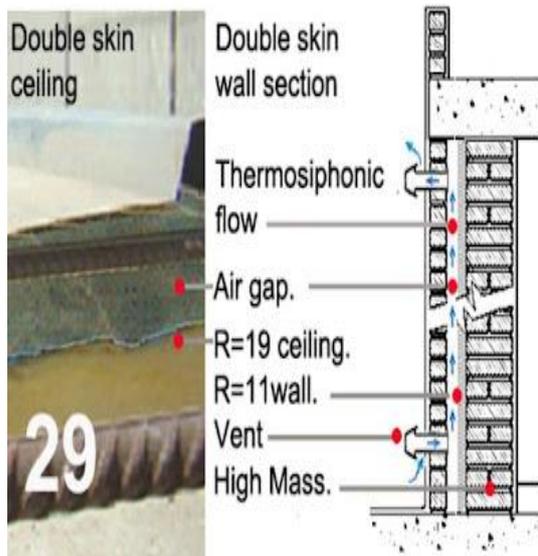


Fig11
Shows The usage of double brick walls to reduce the heat of indoor spaces

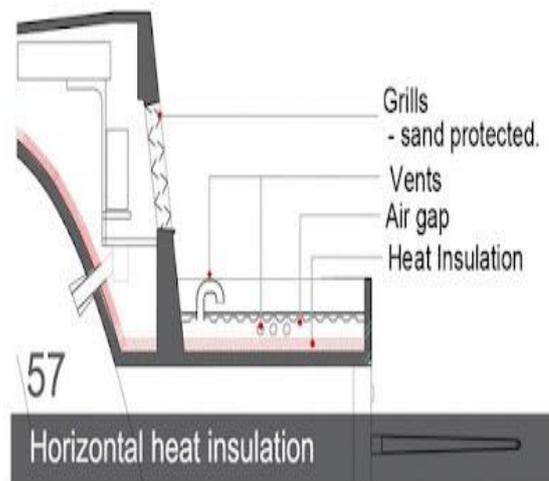


Fig12
shows horizontal heat insulation layers

a. The Egyptian Architect Tariq Labib influence by Hassan Fathy concepts:

At the beginning of his architectural career, the architect Tariq Labib was influenced by the works of Hassan Fathy and Wissa Wassef, who represented the starting point for him to search for architecture suitable for the climatic conditions in Egypt, where he spent more than fifteen years engaged in research on reducing energy consumption, which resulted in the preparation of a set of formulas and equations. Which helps architects test the climatic characteristics of hot, dry or humid areas and thus reach the best building materials and insulation materials that help the building perform its function in providing a suitable place for living or working within a vacuum space that provides people with permanent stability in temperatures. This is what is called the thermal comfort and the greatest challenge for humanity is embodied in finding alternative solutions to the energy crisis. Tariq Labib prompted that the architecture must not be isolated from the problems of his society and added that we have to return to Egypt to practice

architecture in a professional manner to build modern Egyptian architecture that is compatible with the contemporary lifestyle.



Fig13

Shows the usage OF bricks, cement bricks and Siwa salt bricks in the execution of canopies in the implementation of internal spaces of the Abusair House

b. Architect Tariq Labib mixed the vocabulary of ancient Egyptian architecture with contemporary modernity:

Architect Tariq Labib mixed the vocabulary of ancient Egyptian architecture with contemporary modernity out of his belief the important role of building modern Egyptian architecture in expressing our contemporary culture .His works were distinguished by as one of the Egyptian icons, such as the abstract shape of the traditional air shaft in Islamic architecture, Tariq Labib’s architecture do not adhere the ancient function, as he uses it freely in his designs to employ it as openings for lighting or as part of the design formation of the building’s spaces or entrances and his designs follow the development that occurs by choosing suitable building materials, and choose the types of openings in its designs.



Fig14

Tariq Labib's abstract form in Islamic architecture uses light sources freely and flexibly.

c.Tarek Labib Interior Architecture Identity:

Architect Tarek Labib tried to create a contemporary Egyptian architectural identity that respects modern energy laws and is compatible with the climatic nature of the region. Environmental treatments such as double walls and the use of thermal insulation with the use of mechanical air conditioning units of a special design and hidden within the building structure and the internal walls and ceilings that combine arches, arches and basements.

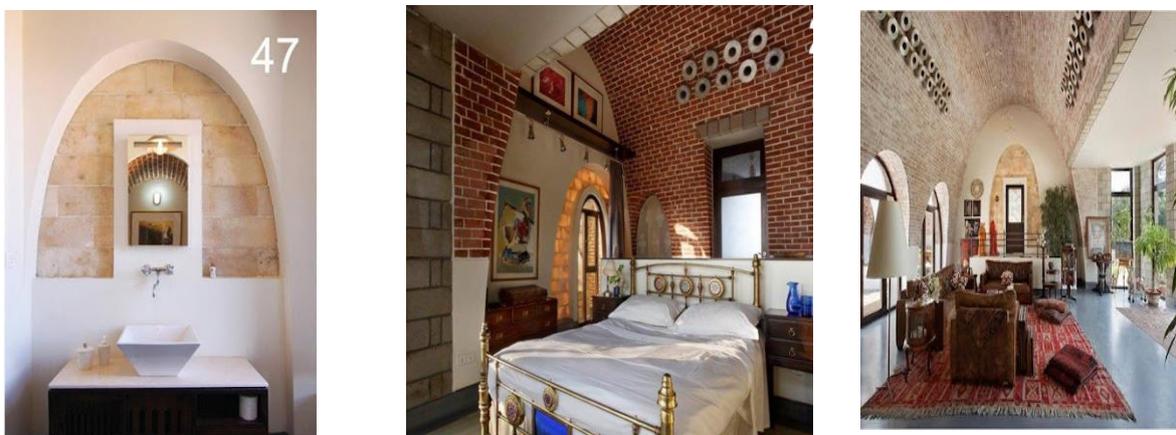


Fig15

Shows The translucency in interior spaces arches and domes that makes a yellow gleam that create a glow over the course of the days

9. Domes and Sustainable Design in Egypt:

Domes modern design and Sustainable Design in Egypt adapt to current needs and challenges, including energy productivity goals which can be presented in many projects such as

9. Al Rayyan Sands glamp in Fayoum desert:

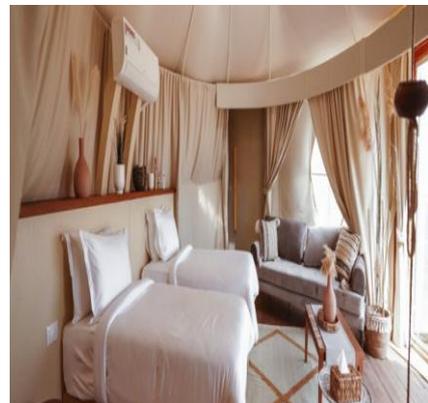
Al Rayyan Sands in Fayoum, the first spectacular eco-tourism project in the heart of the Fayoum desert, specifically in the Wadi Al Rayyan area. " Al Rayyan Sands" A new tourist project in Egypt offering a 5-star service, based on the use of eco-friendly materials "Rayyan Sands" project, using a specialized design office to implement Camp "Rayyan Sands" in the heart of the Fayoum desert in which there is a global trend to expand ecotourism and nature exploitation projects ,especially in promising desert areas such as the Whale Valley.



Fig16

Shows The ecological glamp's represented in the Geodesic wooden arches ,stunning beachwood exterior and neutral color scheme, back-to-basics camps scattered throughout Fayoum

The glamp was constructed with locally-sourced and environmentally sustainable materials. They even went as far as acquiring stones from the surrounding deserts to incorporate into the infrastructure.



•**Conclusions:**

It is well known to architects and interior designers the necessity of developing the building structures forms depending on local material TO create a contemporary Egyptian architectural identity that respects modern energy laws and to preserve the identity in a modern spirit and reduces energy consumption.

•**Research outcomes:**

1. The necessity of linking the exterior structure and the interior design of the building.
2. The necessity of designing interior spaces compatible with the climatic nature of the region.
3. The necessity of spreading modern interpretations of ancient techniques across Africa.
4. The necessity of creating openings for lighting as part of the design formation of the building's spaces or entrances.
5. Applying interior designs that follow the choosing of suitable building materials and ecofriendly local materials.
6. encouraging the reviving of Hassan Fathy sustainable solutions in building direction, dome, roof, walls and ventilation design aspects.

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