Sustainable Architectural and Urban Development.
The Impact Of The Evolution Of The Architectural Heritage On Sustainable Architecture In Egypt.
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Abstract.
Egypt has acquired the heritage of four consecutive civilizations; Old Egyptian civilization, Greek-Roman civilization, Coptic civilization and Islamic civilization, which all had a great impact on multilayers of various cultures as well as forms and concepts of vernacular architecture and concepts of architecture, thus leading to Sustainable Architecture.

This paper is suggested due to the great impact of such cultures, resulting from the evolution of those civilizations, on the form and concept of local vernacular architecture and thus on Sustainable Architecture. This has allowed assumptions, beliefs, goals, and knowledge, underlying the endeavor to design buildings that address Sustainable Architecture. The analysis of architectural heritage has also identified beauty, climatic values, natural and local cultural environments, construction methods and technical systems which all image architectural sustainability. All these factors can be overlapped embodying different images of vernacular architecture. Finally, this paper defines architects conceptualization reflecting Egypt’s heritage, which mirrors the layers of those various cultures against strategies for environmentally Sustainable Architecture.

Introduction.
The impact of heritage in Egypt is not easily definable and even less regained. This is most true in countries having a long and complex history such as Egypt, where various cultures have accumulated for over 5000 years. Such a distinguished history has influenced early civilizations to great extent reflecting several images for Sustainable Architecture in terms of social context; materials, construction methods and techniques and building designs. This has helped in establishing a quaint representation for history and traditions, where such images were adopted by Hassan Fathy and Ramses Wissa Wassef in Vernacular Architecture.

Sustainable designs we confront today are fundamentally the result of Egyptian Heritage accumulated through multilayers of several cultures, the sustainability of a culture as tradition depends upon human capacity to learn and to transmit knowledge through history to succeeding generations, leading to the several images of sustainability; natural, technical and cultural.

The aim of this paper is to illustrate aspects of Sustainability inspired from Egyptian Heritage and adopted in Vernacular Architecture in order to achieve an appropriate Sustainable Architecture. It, also, discusses prospects of several levels of Sustainable Architecture, strategies and concepts. Finally, it compares Sustainable Images inspired from the evolution of heritage with those adopted in Vernacular local context.

Images of Sustainable Architecture.
Here we shall present just three contrasting images of architectural sustainability, which we shall refer to as: natural image; cultural image and technical image, for the sake of shorthand due to their complex association of ideas that they embody. The natural image is the key to architectural sustainability to work with nature. Which, sensitively exploits designing with nature at building level the symbolic manifestations of this image reinforce identification with nature as materials such as pressed mud bricks, rammed earth, stones all having natural finishes. The cultural image portrays a distincteful and meaningful genius loci where architecture is part of it. The symbolic and aesthetic manifestations of the image reinforce identification with authentic place as well as celebrate
discernible difference between places\textsuperscript{4}. Since local vernacular mode of a building is seen as having authentically emerged as a response to local culture and the genius loci it is the model and form of buildings, materials and colors that draw on this local vernacular. The technical image to be introduced and passed to others, (using materials) which portrays technical image in the solution. These three images are simply presented as corners of a triangle; if we look at buildings including vernaculars, we are likely to find two or all of our three images reflected from the inspired heritage\textsuperscript{5}.

\textbf{Natural Image of Sustainability.}

\textbf{Materials.}

Materials are those of nature with little human modification or interference. The use of available traditional materials such as mud bricks and stones can be seen throughout the evolution of the Egyptian civilizations\textsuperscript{6}.

Wet Nile mud bricks were used in buildings dating back to the earliest tomb in the Old Kingdom and later by Ramses. The Romans, the Christians, and the Muslims, which were used as logical and available practical materials, mixed with chopped straw and sand. The whole process of brick making in old Egyptian architecture is similar to that used today\textsuperscript{7}.

These bricks were found in some cases uncovered and in others covered with natural colors. (Fig.1-A) Mud bricks proved through history durability and cultural applicability as well as its low cost, energy efficiency\textsuperscript{8}. Natural stones were also used due to their high thermal capacity and durability.

In vernacular architecture, both of Hassan Fathy and Ramses Wissa Wassef has adopted these materials in their constructions. (Fig. 1-B) Hassan Fathy was influenced by the vernacular Architecture of the Nubian when he saw that mud could be used in a wider scale due to the association of mud with poverty. We also find that Hassan Fathy has added straw to sand from the desert and mixed them with water. Natural stones are also used and kept uncovered in several examples of Fathy’s works\textsuperscript{9}. While Ramses Wissa Wassef, has added gypsum to the mud giving the bricks more solidity, which has kept it lasting until today\textsuperscript{10}.

In this case material emerges the need for architecture to join rather than separate people from the natural world. This proves Fathy’s belief in the need for uniting with nature\textsuperscript{11} representing natural image of sustainability.

Also, the materials that Fathy has promoted vernacularly represent his own cultural tradition rendered in Mud historically and environmentally an appropriate and plentiful material.

Through evolution of civilizations, we can see that natural images of Sustainable Architecture by using available local materials have influenced Vernacular Architecture through natural materials and finishes resulting in their adoption vernacularly over lapped with technical images.

\textbf{Cultural Image of Sustainability.}

\textbf{Forms - Construction Methods - Building Design.}

Construction Methods mirrors the local cultural image through forms and methods emphasizing local involvement and local expertise in local vernacular\textsuperscript{12}.

\textbf{1-Forms.}

Form must be understood with both its environmental and its cultural contexts and as an example that buildings which follow the local vernacular.

Local vernacular is the direct and unself–consciousness in the physical form of a culture.

Through out most of its distinguished history, Egyptian culture radiated resulting indigenous historical forms, examples of which are the granary in ancient Egyptian history (Fig. 2-A); the vaulted areas behind the temple of Ramses II near Aswan; Wadii El Natrun monastery\textsuperscript{13}; the Christian
cemetery of Bagawat made of mud bricks with large burial vaults; and the Fatimid tombs (Fig. 3-A) in Luxor with their domed roofs\(^14\); as well as the domes of Sayedna Yousef Ramses adopted in Hararanya (Fig. 4-A) and (Fig. 4-B). Most of these forms are adopted vernacularly in Fathy’s works it is a clear reflection for several images (Fig. 2-B) and (Fig. 3-B) through nature and culture.

2-Construction methods.

Construction Methods mirror the local cultural image through forms and methods emphasizing local involvement and local expertise in local vernacular.

Construction methods applied throughout Egyptian civilizations were simple, easy to implement and manipulate. Thick bearing walls were used to support roofs; flat, vaulted and/or domed roofs. Using locally available materials (mud bricks, stones); vaults were constructed by the erection of the kick-wall forming the parabolic shape of the vault\(^15\)(Fig. 5-A). Meanwhile, mud bricks and stone vaults (Fig. 6-A) have evolved through the different civilizations in different forms; from being constructed either using squinches or pendentives transforming the square to the pentagon on to the circle form (Fig. 7-A) which all carry the dome. These construction methods have resulted in several forms (Fig. 8-A) In other context, it was not just nostalgia that has drawn Hassan Fathy and Ramses Wissa Wassef towards historic development when they rediscovered these curved forms (Fig.9-A) arches, vaults, domes and spheres with their construction methods\(^16\) (Fig.5-B) and (Fig.6-B), But being inspired by the evolution of civilizations, they adopted such methods leading to this vernacular response. These inspired forms represent an emblem of cultural image in Fathy’s vernacular designs combining several elements inspired through heritage,(Fig.5-B) and existing sustainability. An example of which is the mosque of the new Gourna inspired from the Vernacular form of the old mosque where he created a style incorporating the essence of his New Gourna socially oriented construction techniques, (Fig. 7-B) tradition and reestablishment of national cultural pride through the act of the building\(^17\).

Ramses and Fathy have succeeded in adopting sustainability of their culture through their response to history and tradition\(^18\) (Fig. 8-B).

The impression that it would be difficult to expand this architectural language to accommodate the diversity and scale of vernacular requirements is a part of the cultural image. The eco-culture and the eco social overlap the cultural image. (Fig. 10-A) and (Fig. 10-B)

3-Building Designs.

Excavations of the early designs of houses through different civilizations in Egypt show that there were several architectural elements reflecting different images of sustainability adopted in vernacular Architecture by Hassan Fathy. Through his studying of the history of his country, he created a series of typologies, which lead him to propose several ideas in his designs. These ideas or proposals caused great admiration of several cultural images inspiring

The following are proposals for building designs through civilizations, which are greatly notable\(^19\) in some elements:

1-Design of The courtyard: used in old Egyptian, Greek-Roman-Coptic and Islamic Architecture, which served for several purposes such as providing privacy repressing social and cultural images;

2-Design of Taktaboush: used in Islamic architecture and introduced in several examples of houses in medieval Cairo; it represent social image;

3-Design of Mashrabia: used in Islamic architecture, providing privacy\(^20\), it represents social image.

4-Design of roofs (domes and vaults): domes through civilizations suggest different meanings. For example a worshiped dome in old Egyptian architecture is the Goddess Nut; in Coptic architecture it represents the sky while vaults represent the cover Nuah Ship. Also in Islamic Architecture, there is a religious connotation of the dome form comes from its symbolic connotation with the sky vault\(^21\).

5-Design of Wind towers: used in the Egyptian and Islamic Architecture.
Building designs adopted vernacularly provides a social image through privacy in designs inspired from civilizations giving sustainable building through design elements.

Technical Image of Sustainability.

Passive energy

Passive energy (Cooling - Heating) are energy systems, which utilize the sun and elements of climate to provide thermal comfort and energy efficiency$^{22}$. Passive energy mirrors the technical image through reducing energy consumption through technical proficiency in using materials, passive devices, natural ventilation in that way the technical image forefronts measurable environmental facts of resource consumption along with economics, operating costs, efficiency in material use and systems$^{23}$. Through design’s elements as follows:

1. **Courtyard:** - The courtyard, which is one of the typologies, Fathy adapted to generate air movement convection to provide adequate climate. As well as shading which represent natural and environmental sustainability.

2. **Taktaboush:** - It is a modification of the courtyard, a covered outdoor sitting area, which is an opening between one, paved and one planted courtyard to induce connective cooling.

3. **Mashrabia:** - Controlling the passage of air current to reduce temperature, it also reduces the reflected heat and solar radiation and allows air to pass through freely.

4. **Roofs (domes – vaults):** - Which is represented in terms of construction methods used historically, it promotes the following:
   - Transfer heat more efficiently and hence more easily cooled
   - Domes & vaults allow more natural ventilation in the higher space it creates$^{24}$ comfort inside houses.
   - The connection between climate and building design have changed from the issue of providing adequate thermal conditions for working and living to the function of promoting energy efficiency$^{25}$.
   - These designs help in regulating energy to be more efficient as well as employing ecological design techniques which considers aspects associated with cross ventilation. Inspired from heritage to be adopted vernacularly and sustainability.

The construction methods with their different forms inspired from the Egyptian heritage dominate an overlap of sustainability images naturally, technically and culturally which have been adopted in vernacular Architecture. It can be noted that these construction methods do not depend on any equipment as well as being resistant to the effects of the local climate.

The technique represented through solutions of construction methods. Proved evolutionary through Heritage by passing it through civilizations. Reducing energy through construction methods of roofs, natural ventilation, and efficiency in materials.

Vernacular technical image of sustainability overlapped with the local cultural image. This technical image was established when Hassan Fathy and Ramses Wissa Wassef introduced the skills of this construction method and taught the peasants how to built by themselves. They applied training programs using affordable material available in the same place without any need for transportation in order to preserve cultural resources.

Hassan Fathy recognized this emblem of cultural image, when he created a style incorporating the essence of his own culture as well as respecting the tradition and not reproducing it.

Finally, it is a very sophisticated and deliberate kind of iconography not only to combine elements with complex connotations that are regional but also to transcend local tradition making a connection with the formation of the Egyptian architectural heritage which in turn images some aspects of sustainable architecture.
Concluding Remarks.

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 as it involves excavations and transportations.

- Domed and vaulted roofs decreases temperature inside the building due to their circular form and thus it is more energy efficient due to less surface area exposed to the sun
- Technically these construction methods could easily be learnt and built without the need of an entrepreneur. Financially it suits low income groups
- Vernacular forms inspired from heritage give several forms of beauty due to the harmony in their forms, some attitudes of achieving sustainable architecture represented through heritage of the past toward vernacular Architecture and have become significant in terms of its environmental solutions representing these images of sustainability. Preventing strategies and concepts inspired from this Heritage.

Recommendations.

Introducing traditional building methods inspired from heritage by the following:

1. Introducing the skills of these methods through training courses to passé the skills to others.
2. The use of domes and vaults as a roof construction method without any equipment.
3. The use of available local materials.

(Figure No. 1-A)
OLD EGYPTIAN ARCHITECTURE: Un rendered mud-brick natural image
Researcher

(Figure No. 1-B)
VERNACULAR ARCHITECTURE: un rendered mud-brick arches adopted by Hassan Fathy.

(Figure No. 2-A)
OLD EGYPTIAN ARCHITECTURE: The vaults of the granaries of El-Ramsum.

(Figure No. 2-B)
VERNACULAR ARCHITECTURE: Forms of vaults by Fathy Bariz.

Forms of vaults inspired from Old Egyptian Architecture represent natural and cultural image of sustainability.
VERNACULAR ARCHITECTURE: Ramses Wissa Wassef granaries at Haraney by Ramses. Researcher


Forms of domes inspired from Old Egyptian Architecture, which perform natural image of sustainability.

(igure No. 3-A) (Figure No. 3-B)

ISLAMIC ARCHITECTURE: The structures of the Fatimid tombs were both partially robust and formally decorative, and helped to convince Fathy of the possibility of building in mud brick. Steele, McGraw-Hill. 1997.

Natural finishing materials, construction methods, similar forms inspired from Coptic Architecture represented vernacularly.

(igure No. 4-A) (Figure No. 4-B)


VERNACULAR ARCHITECTURE: Gouaches of Abd El Razek House are greatly influenced by forms and construction methods of Islamic architecture. Steele, McGraw-Hill. 1997.

(igure No. 5-A) (Figure No. 5-B)


Construction methods of vernacular architecture reflect technical and natural images of sustainability.

(igure No. 6-A) (Figure No. 6-B)

GREEK ROMAN ARCHITECTURE: natural stones Koum Aoshim-El Fayoum. Researcher

GREEK AND ROMAN ARCHITECTURE: Abou Mina
pendentive Dome with mud brick and stones at
king Maryout.
Researcher
Construction methods reflect natural image of sustainability.

VERNACLAR ARCHITECTURE: Pendentive
adopted by Fathy in his works as a construction
method.

COPTIC ARCHITECTURE: The vaults of Dair Anba
Bishoy Wadi El Natroon.
Researcher
Forms of Vernacular Architecture inspired from Coptic Architecture. Natural finishing
materials represent natural image. Inspired in vernacular forms from Coptic Architecture.

VERNACLAR ARCHITECTURE: Shallow domes-
the vaults of El Haraneya.
Researcher

COPTIC ARCHITECTURE: Coptic Architecture
colours- openings and forms of domes 7th-8th
Century.
Researcher

VERNACLAR ARCHITECTURE: Ramses has
adopted the same colours –opening- form.
Researcher

ISLAMIC ARCHITECTURE: Wooden domes at
mosque of Mohamed Aly.
Researcher
Forms of vernacular Architecture reflects natural image of sustainability inspired from Islamic
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