Earth Architecture in Rural Egypt: Changes in the Context and the Material


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Abstract: *The rural villages in Egypt have a long history and tradition for earth architecture. However, these villages have undergone many changes, which resulted in the gradual disappearing of earth architecture. Instead, contemporary building materials are taking over the building industry. This has led to many environmental, economic and social problems. Earth, on the other hand, is a natural material, which has a very low impact on the environment, when compared to concrete and red brick. After many years of innovations and technologies in the field of earth construction, the material was developed technically, structurally and also, esthetically to withstand the current building challenges. The study aims to identify the challenges for creating middle density rural villages in Egypt using earth as a building material and analyze the significance of these challenges nowadays. The methodology literature review using case studies of the Egyptian rural context changes from the past to the present and how these changes resulted in the disappearance of its traditional earth architecture.*

Keywords: *Rural housing, population growth, vertical extension, earth construction techniques, Egypt.*

Mısır'da Dünya Mimarisi: Bağlamın ve Materyalin Zorlukları

Öz: *Mısır'daki kırsal köyler, dünya mimarisi için uzun bir tarihe ve geleneğe sahiptir. Ancak, bu köyler, toprak mimarisinin kademeli olarak ortadan kalkmasıyla sonuçlanan birçok değişikliğe uğramıştır. Buna karşılık, çağdaş yapı malzemeleri de yapı endüstrisini ele geçirmektedir. Bu durum birçok çevresel, ekonomik ve sosyal sorunlara yol açmıştır. Toprak, beton ve kırmızı tuğla ile karşılaştırıldığında çevreye etkisi çok düşük olan doğal bir malzemedir. Toprak inşaatı alanında uzun yıllar süren yenilikler ve teknolojilerden sonra malzeme, mevcut bina zorluklarına dayanacak şekilde teknik ve yapısal olarak geliştirildi. Çalışma, yapı malzemesi olarak toprağı kullanarak Mısır›da orta yoğunluklu kırsal köyler yaratmanın zorluklarını belirlemeyi amaçlıyor. Beklenen sonuç, Mısır›ın kırsal bağlamında yeniden kullanılması için dünyanın karşılaştığı zorlukların belirlenmesidir.*

Anahtar Kelimeler: *Kırsal konut, nüfus artışı, dikey uzatma, toprak yapım teknikleri, Mısır.*

1. INTRODUCTION

Nowadays people in rural areas of Egypt tend to use concrete and fired brick masonry instead of Earth as building materials. These materials are responsible for not only environmental problems such as carbon emissions, energy crisis and waste accumulations but also, economic problems as these building materials' prices are in a continuous increase. Not to mention that the use of conventional building materials in such a context leads to the loss of its valuable tradition and culture. This has transformed the villages into an informal imitation of the city. On the other hand, earth has many advantages to the environment since it is totally recyclable and also affordable.

This raises the questions, what are the current village needs? Is the earth really unable to fulfill those needs? Are the earthen building materials unable to cope with these changes? What are the barriers that face this material in the rural Egyptian villages?

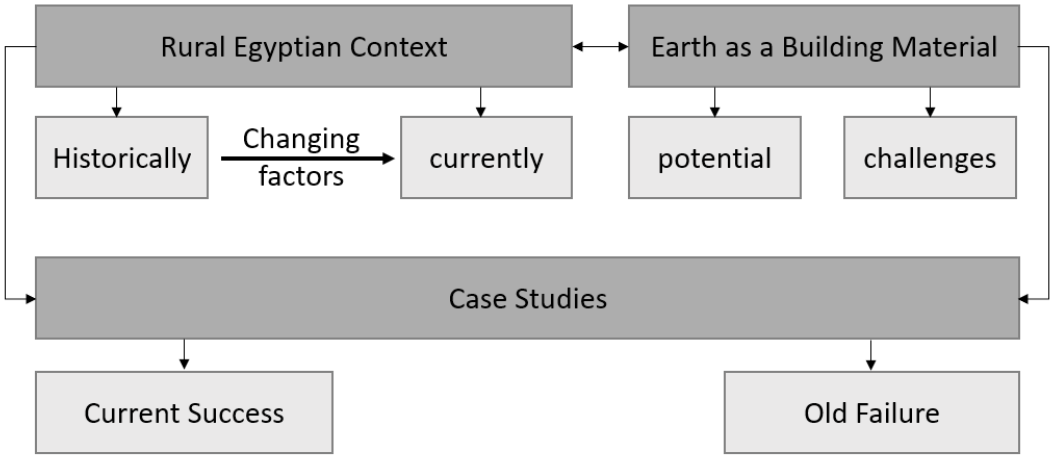

Figure 1. Research Strategy (by author, 2021)

Part 1: Evolution of the rural villages → their current needs and challenges

Part 2: Earthen material properties → potentials and challenges

Part 3: Case studies → reply to the question of the significance of the material challenges nowadays

Part 4: Discussion → findings of the three previous parts discussed.

This paper aims to identify the changes and challenges in the context and the challenges of the earthen material. Moreover, evaluate the significance of these challenges nowadays in hindering the use of this material in this context using two different case studies from two different times in the same location.

2. EGYPTIAN RURAL CONTEXT

This section will make a comparison between the Egyptian rural village historically and currently on an urban and building scale. Moreover, discuss the different factors which have led to these changes in the context. Through this narration, it will be possible to understand the challenges that context has and the barriers, from the context perspective, for the reuse of earth in these villages.

2.1. Historical Village Characteristics

The Egyptian village is the original form of human settlement in Egypt's history. It's the basic unit that adheres to a social system with all its customs, traditions, and institutions that are inherited from ancient times [17]. The Egyptians were the first settlers who cultivated, built and organized social, moral and political life. The present village of the Nile of which there is so much complaint, is the direct heritage of a people who gave the world its oldest civilization [3].

2.1.1. Urban scale

The typical rural villages can be described as a compact settlements surrounded by intensively cultivated fields [7]. For more than 5000 years, the rural Egyptian villages were restricted to the area on a hill to be protected from the Nile flooding. The planning of the rural villages is a reflection of the relation between the village inhabitants. The people are grouped in clans and the planning of the village was the same: the planning suits separate quarters where open spaces are left between each group. These open spaces gave the opportunity for interesting public activities to happen such as market places, play-grounds, or places for mosques and churches.

2.1.2. Building Scale

These villages were characterized by the mud family house. This house was a social catalyst which was built by the family and relatives and extends by adding more units to accommodate new family members. The housing unit for the peasant is an "organic creation" that aims to fulfill his fundamental needs. This historical and traditional creation is directly connected with the agriculture, cattle and the growing society in the rural Egyptian villages. The house was based on the grid of around 3x4 square meters and connected within an alley from two to three sides to other houses.

The social and economic class of the family affects the size of the house. There is a minimum of three particular classifications that represent the economic status of the rural village inhabitants. These are as follows:

- The well-to-do peasant
- The middle peasant and
- The laborer or very poor peasant [3].

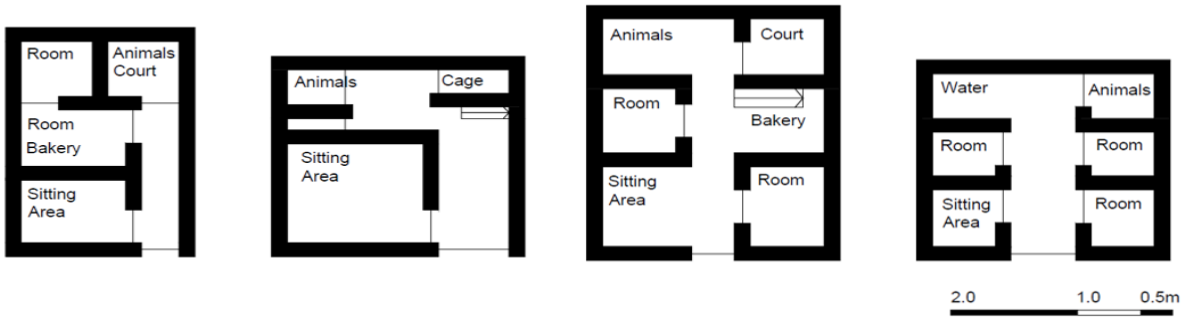

Figure 2. Typical medium rural housing typology (Redrawn by Author from sketches by Dr. Fathy M. Muselhi, Between the Problems of Comprehensive Development and Village Planning: Urban Egypt at the beginning of the 21 Century (Dar El Maarif Al Gamia. Alexandria, 1990)

The smallest house was consisting of one room for sleeping and also for receiving guests. At the end of the house, the animals' cage can be found (Figure 2). The roof was used for storing corn (maize) and cotton stalks, as well as dung cakes which are used for fuel. Roofs were also favorite sleeping places in hot summer nights. The middle-class house had an additional multi-purpose zone while the rich house was bigger and had a more prominent location.

(1) First rate dwellings for rich and leading groups 10 %
(2) Middle class dwelling 20 %
(3) Ordinary dwelling consisting of one, two, or three rooms 70 %.

Most of the rural housing units were built using the local building materials. Those local building materials are widely available and they just need good observation for the resources available on site.

The mud brick was one of the most used building materials which was available excessively along the Nile (Nile sedimentation), also, from excess mud from the agricultural land (later became permitted by law) or the cleaning up of water canals. Along many years the villagers have gained valuable experience to know the characteristics of these raw materials and to make full use of them.

Figure 3. Peasant making sundried clay bricks (Borchardt, 1929)

The peasant had to make the mud brick house himself and he only request the help of a mason for the construction of the walls. All the rest of the building process such as plastering, roofing, or flooring was done by himself, his family, and some relatives and friends. The villagers used to assist each other when constructing a house and every member had a specific role to do such as that the women were responsible for plastering the walls from outside and inside. Participation was perfectly applied in the community. This can be analyzed through many perspectives; however, it is clear that the construction material is one reason for that. Suitable building materials and techniques of construction have to be chosen for a successful community participation in rural housing. The adequate building technology facilitates and eases community participation [19]. Moreover, more sophisticated and higher construction technologies progressively decrease the direct involvement of the community members in the building process for some authors [13].

2.2. Reasons for the Change

During the last fifty years, the rural villages have undergone huge transformations. Many aspects have caused these transformations to appear in the rural villages. These transformations can be classified as economic, environmental, and political changes.

2.2.1. Economic

• **Modernization/ Industrialization:** The Egyptian economy started to transform from agriculturally based economy to an industrialized economy. This has opened the door for many new imported building materials to be available in the Egyptian market.

• **Land prices**: In the rural villages of Egypt the annual housing demand has reached 460,000 households according to CAPMAS 2017 report [6]. CAPMAS is the Central Agency for Public Mobilization and Statistics is the official statistical agency of Egypt that collects, processes, analyzes, and disseminates statistical data and conducts the census. Moreover, the land prices are significantly high because all the land plots are suitable for agriculture. In addition, the villages became a place for the affordable housing seekers especially those villages which are close to the cities [17].

• **Peasant immigrations:** A lot of the poor peasants started to immigrate to the Gulf areas to upgrade their living. After returning, they wanted to imitate the "modern" styles and materials in their villages [17]. Besides, many mud houses were abandoned without any maintenance.

2.2.2. Environmental

• **Global warming:** Most of Egypt is a desert and is classified as arid (except for the Mediterranean coast, which is semi-arid). There is evidence that the severity and frequency of flash flooding across Egypt has increased in recent years [21]. Therefore, historically, earthen buildings were not in threat of excessive rain so no proper insulations and proofs were installed, which resulted in many destroyed earth walls in the villages and this led to the "poor image" of Earth.

2.2.3. Political

• **Aswan High Dam Construction:** After 1961, the annual flooding has stopped after the construction of the high dam which freed the villages from staying on top of the hills and allowed horizontal expansions. The less water means less mud for the construction industry.

• **Laws and Regulations:** Law number 154 of 1980, article 150 and 151 on agriculture (Also check Agriculture law issue No. 53 (1966) and an addition of law No. 116 (1983)) prohibit the use of soil from the fertile agricultural land in any act of construction. Also, they prohibit building on agricultural land

2.3. Current Village Changes

The previously mentioned factors have led to major transformations in the rural Egyptian village. They have restricted the availability of the earthen materials and made the "modern" building materials widely accessible. It has not only created a bigger housing demand than before, but also, built a social barrier for earth construction as being an old fashion and poorly imaged.

Table 1. Change in the rural villages with reference to scale

	Reason for change	**Change in the Built-environment**	**Scale**	
			Urban	**Built**
Economic	Modernization	Easier accessibility to "modern" materials		●
	Land prices	Denser housing typology	●	●
	Peasant immigrations	Deterioration of the earthen buildings		●
Environmental	Global warming			●
Political	Aswan High Dam	Lack of availability of earthen material	●	●
	Laws and Regulations		●	●

As the villages grew, the need for formal and informal initiatives grew, as well, to conserve architecture in the Nile Valley from the major threats. Formal initiatives by planners, decision makers and local authorities are producing comprehensive plans for all Egyptian villages. It can already be observed in numerous villages. They are starting to lose their identity and being transformed to informal housing imitating the big cities in Egypt: Reinforced concrete multi-storey buildings with no identity, aesthetic, environmental or functional values [16].

1.2.3. Urban Scale

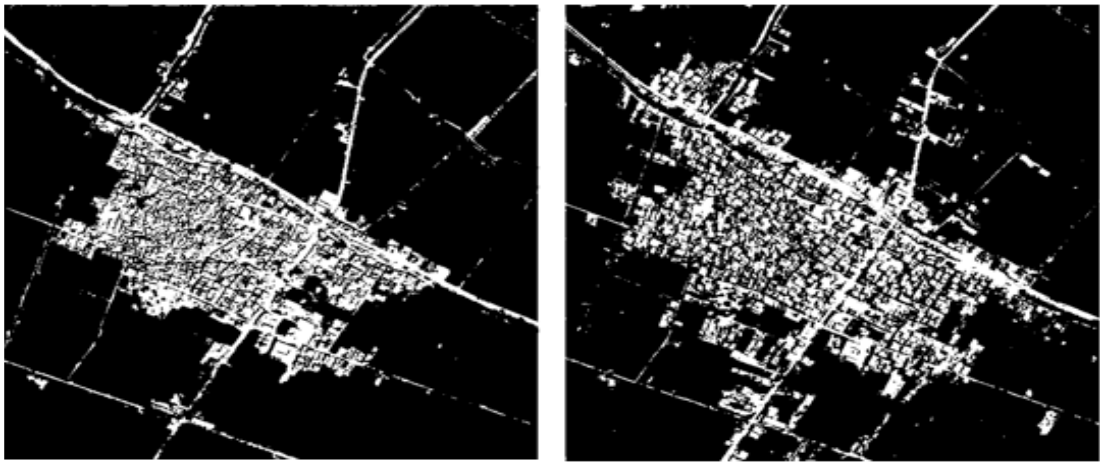

Figure 4. Mit Gaber, Sharqia google earth images of 2005 (left), 2020 (right)

During the 20th century, the villages broke loose from the island village. They started to expand outside the original hill on which the village had stood for eras to decertify agricultural land by constructing more settlements for the dramatically increasing populations. The excess increase in population is a complex issue as the soil which is suitable for farming is limited to a thin strip along the river Nile [16]. Numerous locals divided their houses or added couple of stories to their current houses and offered them for rent. Some destroyed their buildings totally and re-construct them with new modifications that are suitable for renting. This trend resulted in the disappearing of the traditional family house design and the imitation of housing design similar to what is found in the informal housing extensions of the major cities.

2.3.2. Building Scale

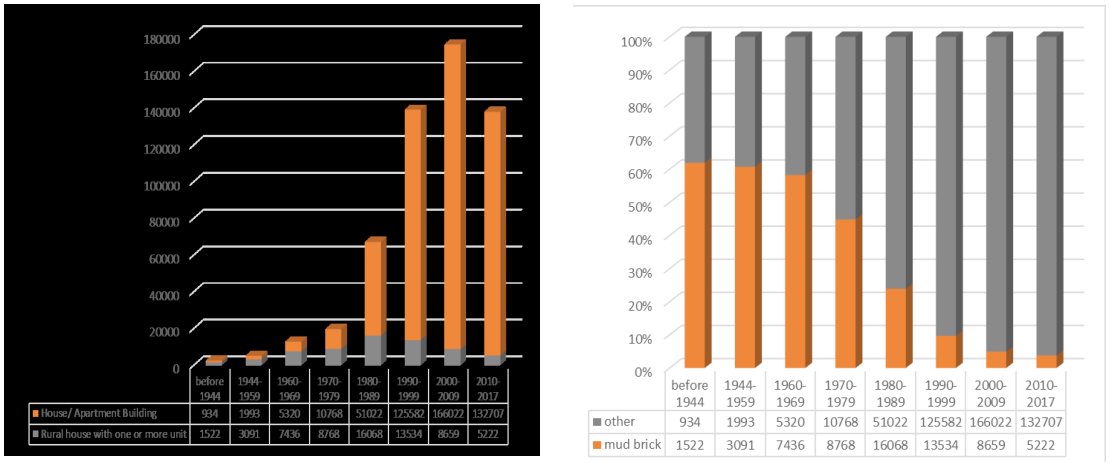

Figure 5. Number of Complete and Fully Occupied Rural Housing Buildings from year 1944 till 2017 by Type of Building and construction method respectively (data by CAPMAS, 2017; by author, 2020)

In the early seventies, most of the family units were single story houses and the rest were two-story houses with extremely few three or more stories high. After the 1973 war, new housing typologies took over the horizontal and vertical extension of rural settlements [17]. In a CAPMAS report of 2007 (latest report) of housing and building, some statistics were issued that reveal some important characteristics of the housing typologies nowadays in the rural villages. In the year of 2000, 50.7% of the households in rural Egypt are the rural house of one or two storey buildings that used to be owned by a family and 28% are Flats [2].

Figure 6. Continuous extension in the villages (by author, 2019)

An obvious observation when visiting those villages is that most of the buildings have untrimmed columns on the roof. This is a real indicator for the real need of expansion and more space for household. The village is in a continuous expansion and construction process. In figure 2, the change of the vertical extension in the village has dramatically increased in only 15 years and this can be seen through the building shadow between the two pictures. In 2016, the Egyptian parliament was discussing modification in the unified construction law 119 for the year 2008. This law is restricting construction in rural areas and making use of the rural expansion to urban. The parliament committee is suggesting the allowance of building the ground floor plus two typical floors whatever the street width is in the villages [21].

Table 2. Comparison between rural villages in Egypt historically and currently.

	Historically	**Currently**
Urban Scale	● grouped in families [17] ● open spaces have social activities ● limited to the island area ● higher crowdedness level ● migration to different village island ● homogenous society [19] ● deep connection to agricultural land [13]	● subdivided and sold/ rented [2] ● new buildings on open spaces ● expand on agricultural land [17] ● vertical extension [21] ● broke loose from the island village [16] ● many outsiders seeking for affordable housing ● non-sense of belonging to agricultural land [17]
Building Scale	● rural family house ● around 12 m2 footprint [3] ●1 to 2 floors ● mud bricks (adobe) [5]	● Apartments [2,6] ● around 12 m2 footprint ● 3 to 5 floors [12] ● concrete and red bricks [9,14]

To sum up, the Egyptian villages that we have today are totally different that have been historically there from an urban and building scales. The historical village was characterized by mud brick family houses however, today it has multi-storey apartment buildings built with concrete skeletons and red brick walls.

These observations indicate that the context has, in a way or another, repelled the earth construction and seemed to have found adequate alternative. What are the qualities that can the earth construction offer to the rural Egyptian villages nowadays? And what are the challenges the material still has? Are these challenges currently significant?

3. EARTH AS A BUILDING MATERIAL

Although earth architecture is rarely produced recently by the locals in the rural villages as is it used to be before, there are actually many potentials for the earth to be revitalized again in the villages. These potentials are ranging from environmental and economical to social benefits. However, there are also challenges that face this material to be capable for meeting the current needs of the context.

3.1. Potentials and Challenges

The material availability in Egypt is a critical issue as being said before that the construction of the high dam and different laws have affected the availability of the material. Clay in Egypt is very important for vegetation and, due to continuous acts of desertification and over use in fired clay bricks; Egypt is losing its agricultural land. As a result, laws were issued permitting the use of Nile sedimentation in construction purposes. However, Egypt was discovered to have another type of clay which is desert clay and, this clay is very suitable for earth construction and does not affect any agriculture. This type is now being used in all new earthen buildings. On the other hand, the earth is nowadays, globally, determined to have the following potentials and challenges:

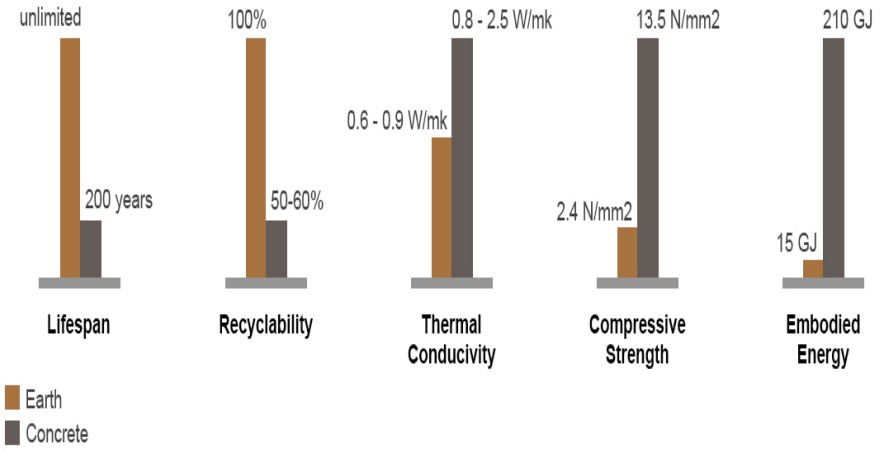

Figure 7. Potentials and challenges of Earth [10]

- **Lifespan (durability):** The meaning of durability when referring to earth is different from that of concrete. Earth is an aging material; this means that year after year, the earth starts to have some wrinkles. This is an important aspect with is inversely perceived by people as non-durable material. In a TED talk in April 2017, Anna Heringer explained that, in her METI School in Rudrapur village, Bangladesh, if a wall has any kind of time deterioration or the edges are not sharp as before, the broken part is taken and made wet and mixed then put back on the wall.

- **Recyclability:** There is no other building material like earth, which is 100% recyclable and environmentally friendly. At the end of life of an earthen building, the building components can be totally recycled with no waste accumulation.

- **Indoor Air Quality (IAQ):** Earth works as humidifier for the building due to its moisture content. It also works as a thermal mass so it works best with hot days and cool nights.

- **Embodied energy:** When compared with concrete and red brick, the earth does not involve any firing

or excessive energy during its production. When produced locally, the earth does not require even transportation and fuel consumption.

• **Compressive strength:** Shibam town's buildings in Yemen are a historical evidence that adobe bricks can bear loads up to 8 storey high and they have been standing for more than 500 years. However, earth building standards still do not permit high rise buildings with several floors and it is accordingly not yet experimented or applied. Despite the fact, earth has many potentials, compressive strength of earth is still a challenge that the material faces when being compared by the other building materials like concrete.

• **Social Perception:** After the modernization and many changes in people's lives and in the building industry, the earth is now perceived as a "poor material". The problem is apparently more related to the perception of the people and the skill of the architects/ designers rather the capability of the material. On the other hand, construction process which not only is simple and does not require skilled labor, but also, promotes user participation and creates sense of belonging.

• **Construction time:** traditional earth construction is a labor-intensive method which requires relatively more time than conventional building methods

• **No standard mixture:** Each soil component is different from one location to the other; therefore, there is no standardized mixture components or ratios during construction. The soil has to undergo testing procedure in order to identify the needed mixture.

Table 3. Potentials and challenges of earthen building materials (by author)

Life Span	Recyclability	IAQ	Embodied Energy	Social Perception	Compressive Strength	Construction time	No standard mixture
Potentials				**Challenges**			

As has been discussed, earth construction has many potentials to be reused in the Egyptian rural villages. Historically, in the Egyptian context, the mud brick is the only used technique for many years. As discussed before, people in the villages have seen the mud brick walls deteriorating which, along with the other reasons, created a social barrier for the earthen use.

Figure 8. Common earth construction techniques (by author, 2021)

According to CRAterre (an Earth UNESCO chair for earthen architecture, which has started in 1979 to revive earth construction material in the building industry using research, education and many projects worldwide) there are more than 12 different earth construction techniques [8]. They are divided into three main sectors in a pie chart: filling in, monolithic and masonry by Houben H, Guillaud H CRATerre 2006 Traité

de construction en terre Éd Parenthèses. Those techniques were historically used and further developed for current projects worldwide like rammed earth, cob, compressed earth blocks (CEB), adobe and many more (Figure 4). However, recent initiatives are starting to introduce these other construction techniques such as: rammed earth and CEB, to the Egyptian market which will be discussed in the case studies if those new construction techniques can contribute to a new revival for the earth construction.

4.CASE STUDIES

The previous sections showed how the context has greatly changed and these changes have created new needs and barriers which doubt the ability of the traditional earth construction method to fulfill those needs. Vertical extension, earthen material availability and social acceptance are among the context needs and the compressive strength is among the earthen materials challenges. The following case studies test the significance of these challenges in reference to different earth construction techniques in the same Egyptian governorate but in two different eras.

4.1. Old Failure: New Gourna Village, Luxor, Egypt

New Gourna village was designed by the Egyptian architect Hassan Fathy. It was partially built between 1945 and 1948, in Luxor. Mud bricks for Hassan Fathy were not only a building material, but also an ideology of interaction between man and his environment.

Figure 9. Hassan Fathi's New Gounra before and after distraction (Aga Khan Trust for Culture and Aga Khan Trust for Culture, respectively)

Unfortunately, in 1948 Fathi's great initiative project New Gourna has witnessed many structural problems. Cracks started to appear on the mud brick (adobe) walls causing many damages to the buildings. Accordingly, the villages left this village and it was never repaired or maintained [1]. The earthen materials, back then, was held responsible for not being durable enough to stand longer. However, the main reason for this damage was the lack of sewage system, which raised groundwater level which resulted in moisture and salt migration, contributing to the disaggregation of limestone within foundations and de-cohesion of mud bricks. In walls, this results in significant erosion, destroying the outer coat of earthen bricks [18].

After some decades from its first attempt to move the residents from Gourna, the Egyptian government repeated the attempt on the same background of protecting Pharaonic monuments. The second version of the New Gourna, known officially as the 'New Al Taref', came totally different from Fathy's New Gourna project. The work in this new village began in 1997 and finished in 2006, while transferring the Gournii to their new homes began on 15 August 2006. In order to force the residents to leave their houses in old Gourna and move to the new site, the government demolished most of these houses [1]. One of the main environmental problems associated with this project is the absence of locality in the whole construction process in contrast to mud brick buildings. The adopted building materials are reinforced concrete and burnt red brick that can be found anywhere in Egypt regardless of their suitability for the specific climatic conditions of the region. In addition, in comparison to the local building materials used in old Gourna, the production of these materials requires much higher level of energy and they are, to a far extent, not recyclable. As an indicator of the irresponsiveness of the used building materials to the harsh climatic conditions, cracks immediately

appeared in some of the new houses, especially between the reinforced concrete beams and columns on the one hand and the red burnt bricks walls on the other hand.

This case study shows that the lack of sewage system and insulation technology have significantly affected the durability of the earthen building causing major structural problems. This has, accordingly, affected the social perception of the material and made it lose its reliability. In this case study, it is, also, clear that "modern" building materials choice is not the solution, where people missed many the potentials of the earthen construction such as: indoor air quality, embodied energy, affordability and even faced structural problems due to the irresponsiveness of the used building materials.

4.2. Recent Success: The Luxor house, Al Rezkyat Bahary, Egypt

Hand Over is a design-build company, which consists of a team of architects, civil engineers, material specialists and builders. They aim to build sustainable buildings using natural building materials to create a social impact and revolutionize the building industry by creating solutions that are environmentally friendly and feasible.

Figure 10. Luxor House roof (Hand Over office, 2019)

Al Rezkyat Bahary is a village is located along the River Nile in Luxor. The village emerged organically between the farmlands overlooking the river. The aim of this project was to design a housing solution in Upper Egypt that would be human-centric, economic and environmentally friendly.

The Luxor House construction started in September 2019. Inspired by the traditional houses and responding to the users' needs, the design team created a shared semiprivate space for the family where they can gather and engage activities. Therefore, a court was designed as a shared central space with a traditional oven included which the family can use for baking. The design included an upper floor to allow the family to expand easily. The upper floor was designed to have one room and a large terrace where the family can gather at night to enjoy a cool breeze. Due to the budget of the project and the time given, the design changed from two floors to only the ground level floor.

Stones were used for the foundation as a strong natural raw material, which is a very reliable material to insulate the earthen walls from being damaged by water. The rammed earth was used for the walls, where humid soil is poured in a wooden formwork in thin portions (10 cm) and then rammed to increase its density and after they were cured, clay plastering was added to give a contemporary appearance to the house.

An important goal in the construction process is knowledge transfer from the master Engineer, to the builders of the project. They would learn to implement challenging forms such as the domes and vaults in the house. The project had a healthy and humane environment on site as the owner and his family was part of the construction process, they shared meals with the workers and helped in small parts of building.

In this case study, the potentials and values of the earth construction can be observed. Rammed earth construction techniques, in this case, is a densified technique where force is applied in each earth layer. This upgrade the compressive strength of the walls and allow the possibility of vertical extension with no

remarkable added wall thickness. Moreover, the well applied insulation technology had a positive impact on the durability of the building. Furthermore, different modern plasters techniques give the building a contemporary look which also promotes the social acceptance of the material.

4. DISCUSSION

After going through the three main focus parts of this paper, which are: the context and the material followed by the case studies, it is crucial to find the interconnections between them to be able to better understand the significance of the material challenges in the current context changes.

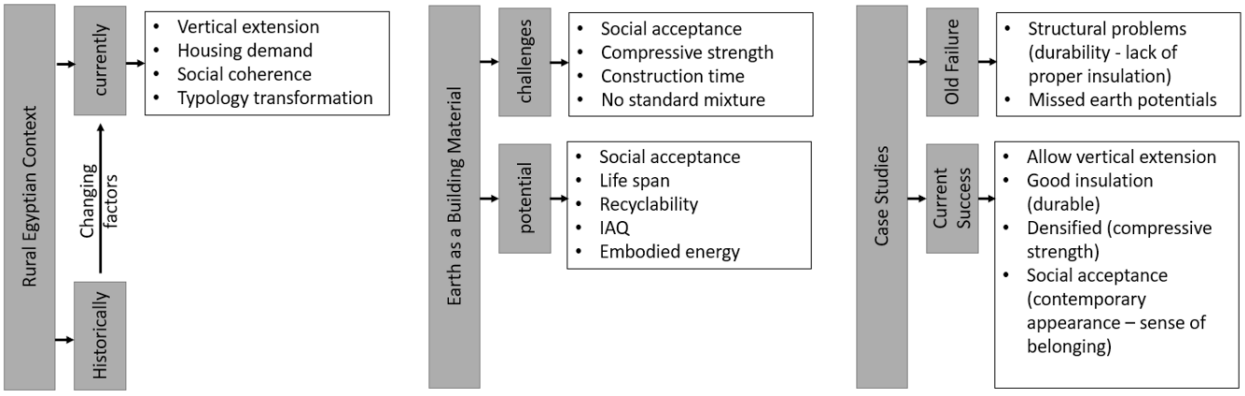

Figure 11. Inter-relations between context and the material challenges (by author, 2021)

As figure 11 shows, the rural Egyptian village is in need for vertical extension due to the dramatically increasing housing demand. Vertical extension requires high compressive strength which is currently possible by using the rammed earth and CEB techniques which are densified techniques that allow multi-storey buildings with no significant wall depth increase. However, the housing demand also needs mass production and relatively quick construction process which is still a challenge for the material. This challenge is now under experimentation after Martin Rauch (Lehm ton Erde) used preproduced rammed earth walls in his AlNatura Headquarters in Darmstadt and Ricola Kräuterzentrum in Laufen.

Moreover, the social barrier is a result of lack of maintenance and poor water insulation as a result of lack sewage system. This can be upgraded through the current insulation technologies in the building foundations which accordingly contribute to the durability and the structural performance of the earthen walls. The social acceptance can also be treated by different modern plasters techniques gives the building a contemporary look which gives a message that earth is no longer an old outdated material.

Further challenges are still available like the wide spectrum of the soil types which makes the building process not standard and requires sufficient experience. However, the villagers are believed to have a great tradition with the earthen material which needs to be revived and rescued from being disappeared.

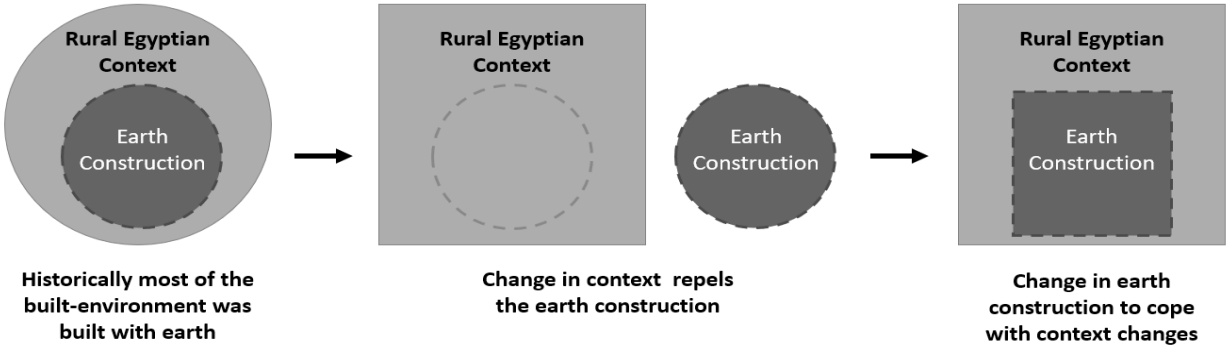

Figure 12. Earth architecture has to change as the context change (by author, 2021)

In the case study, an important conclusion in that "modern" building materials choice is not the solution, where people missed many of the potentials of the earthen construction such as: indoor air quality, embodied energy, affordability and even faced structural problems due to the irresponsiveness of the used building materials. Earth construction, also, contributes to the homogeneity of the society during the building process which we currently miss at the rural Egyptian villages. However, the traditional earth construction technique is also not the solution (see Figure 8). The earth construction requires a contemporary upgrade to contribute to the material acceptance and the villager's needs.

5. CONCLUSION

The rural villages in Egypt have a long tradition with earth architecture. However, this material is starting to be replaced by the conventional building materials which have a huge negative impact on the environment, economy and society. The villages have huge need for expansion due to high rates of population growth. The horizontal expansion is not a valid option to be able to preserve as much of the precious agricultural lands as possible.

Earth, in return, has huge environmental potentials such as very low embodied energy, recyclability, no waste accumulation and high thermal performance. The only earth construction technique that was tried in Egypt was the mud brick (adobe). This is a very ancient technique, however, there are other techniques that have shown potential to be used in the rural Egyptian context such as rammed earth, CEB and cob. These techniques are proving to upgrade the earthen materials as it has a better compressive strength and durability than the adobe.

It is crucial to test the different earth construction techniques using different desert clay soils from Egypt to know if the compressive strength of earth can allow medium density housing (three or more floors) in the rural villages. Moreover, to investigate the impact of using different earth construction techniques on the structural thicknesses, effective floor area, thermal behavior, energy savings and economic savings. Moreover, the initial building costs, embodied energy, life cycle analysis and carbon emissions have to be taken into account as well. All of this has to be compared with the conventional building materials to be able to have thoughtful recommendations for alternative building materials and techniques for the rural Egyptian villages.

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