

**41st IAHS World Congress on Housing  
Sustainability and Innovation for the Future**

**September 13 to 16, 2016**

Albufeira, Algarve, Portugal

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## REVIVING EARTHEN ARCHITECTURE IN PALESTINE: THE ADDED SIGNIFICANCES OF THE BUILDING SUSTAINABILITY AND AN OPPORTUNITY FOR THE FUTURE

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**Keywords:** Earth Building Techniques, Building Envelope, Social Housing Refurbishment, Low Cost Techniques, Rebuilding Palestine, Social Participation

*Abstract* Several attempts have emerged recently in Palestine aiming to find an economical-environmental alternative building material beside the widely-used natural stone as a main building material, due to some factors related to the cost and the negative effects of stone mining areas on the local environment. Similar attempts had a certain response to the peculiar social needs and economic situation there. The efforts led to revive earthen architecture on organizational and individual levels, producing a certain number of earthen buildings in the last few years.

*In order to evaluate the appropriateness of earth as an alternative raw material in Palestine, the paper outlines the general advantages and limits of this building material, in comparison with the current prevalent way of construction and discussing the different needs in rural and in urban contexts, taking into account the housing emergency due to the successive military attacks there.*

*As in other realities, also in Palestine a radical transformation has occurred in the traditional built environment that is possible to be assessed by a multi-scale analysis, in the urban fabric as well as in the minor building components. In addition, the critical condition as a consequence of the well-known peculiar political situation, distinguishes the social housing situation in Palestine, increasing the humanitarian aspects in the wider scenario of the social, economic, and environmental aspects.*

*The aims of the building sustainability, mainly focused on the energy efficiency and environmental impacts in the European Union, but in a context such as Palestine, it acquires an added significance. The earth architecture could assume the role of a social inclusion tool, thanks to its inherent meanings that overstep the material and technical dimension, to the human factor being the main leverage of innovation.*

*The paper will describe some strategic and integrated proposals aiming to face the limits of earthen architecture, discussing if and how the revival of this ancestral building material can help in gaining a useful innovation for the future, in Palestine as well as in the most parts of the Mediterranean region.*



## 1. INTRODUCTION

Earth is considered as the most accessible and cheap material in the world. It was used in different forms, following different human needs, achieving intangible traditions, and matching the local culture and climate in any context. Several studies have been carried out to focus on the deep roots of earth material, for which a common ‘technological continuity’ to the whole Mediterranean basin has been evoked [1]. In addition, the refreshing of earth techniques for current buildings has often been pointed as a sustainable choice for the architecture of the twenty-first century [2, 3].

Earth architecture has begun a tool to face the critical social housing situation in different countries, even in Palestine, where this choice is additionally encouraged by the difficulties of importing building materials (steel, concrete, etc.), and by the high financial and environmental costs of other used materials, such as the natural stone.

A group of attempts have emerged recently in Palestine to revive the earth as an alternative construction material to some extent. This opens up a door to rethink of the achievement of environmental needs, and the enrichment of socio-cultural aspects within the design of the earthen house. Different earthen buildings were implemented since the last decade in the Jordan valley, Jericho city, Dyouk village, Aqbat Jabr refugee camp, Bardalah village, Aqrabaniya village, and Gaza strip (Fig. 1, 2). These attempts of reviving earthen architecture in Palestine were carried out and implemented individually or by some non-governmental organizations such as UNESCO, Shams-Ard Environmental Design Studio, and BGF (Building Green Futures).



Figure 1. New earthen construction in Ramallah, Jericho, Gaza, and the Jordan Valley, Palestine [UNESCO Ramallah Office, Shams-Ard EDS, <[http://news.bbc.co.uk/2/hi/middle\\_east/8068864.stm](http://news.bbc.co.uk/2/hi/middle_east/8068864.stm)> (04/15)].



Figure 2. New earthen construction in Ramallah, Jericho, Gaza, and the Jordan Valley, Palestine [UNESCO Ramallah Office, Shams-Ard EDS, <[http://news.bbc.co.uk/2/hi/middle\\_east/8068864.stm](http://news.bbc.co.uk/2/hi/middle_east/8068864.stm)> (04/15)].

The strategies beyond these attempts were to present earthen architecture combined with new and recycled materials (locally collected) to reduce costs in providing ecological housing in emergency situations [4]. Implementations were focused on constructing community centres as examples for the society, looking for sources of inspiration, learning from the Past for sustainable technological innovation, and locations of high thermal excursion. The public participation was considered as one of the focal points in these projects. Nevertheless, after a number of years since the implementations, a certain post-occupancy evaluation should take its place in order to get a direct feedback from occupants about the efficiency of the system, the building, the earth material, etc.

## 2. CONTEMPORARY AND TRADITIONAL BUILDING IN PALESTINE

The Palestinian architecture shows a big leap between the Past and the Present: the excessive use of natural stone in construction following the “copy and paste” mode, without paying attention to the identity, the nature, the context, or the economic levels of people. A randomness of urban fabric has been emerged recently, losing the social interdependence, buildings are scattered without order, the nonexistence of a certain architectural style, and a dramatically lack of attention towards environmental and economic aspects. Mostly, the paterfamilias are spending most of their lives to build their homes, due to the high construction costs, where this issue was not shaping a great responsibility before.

The gap between traditional building and current constructions is usual in many other places

in the world. While in Palestine, there are some critical conditions, produced as a consequence of the peculiar political situation. For this, the humanitarian aspects, in addition to the social, economic, and environmental ones, distinguish the social housing situation there.

In Palestinian cities or villages, the urban fabric was harmonious and homogeneous on the physical and social levels [5]. An identity of the architectural styles can be observed, strong extended family relations were existed, and people were involved in the design and construction process of a neighbour's house. The important influential factors in the formation of urban contexts and the determination of architectural style were the climate, the construction materials, the site geography, the culture, and other people's living needs. The house-style was evolved through the cooperation of several successive generations starting from using of primitive methods of construction without the need for designers [6].

The house was not just a haven for the Palestinian family. The functional design of a house was not limited to the finding of physical space to shelter families; it had an integrated system of social activities that extended to the external simple yard as a collective social space. The house form also accompanied by regarding the culture of the conservative community, and the awareness toward the environmental needs. On the level of construction material, they used mainly the natural stone, with a limited use of earth in Jericho and in some other regions. The high availability of earth and the suitable climatic conditions there facilitated the use of earth in its common form of bricks.

The Palestinian contemporary buildings differ radically from the traditional ones, with no longer of any great interest to respond to the environment, not even the principle of preserving the architectural identity. Most of contemporary buildings do not fit a certain architectural and urban morphology, with no respect to the climatic conditions. A huge number of buildings have emerged in their random form, and without unity. Buildings only share the stone as a construction material; nearly equal sizes of windows in different climatic zones. The use of earth has disappeared, a huge use of natural stone material with exaggeration and overstatement in most cases, which affects the nature by the increasing number of the stone mining locations [7]. A sporadic and incoherent urban fabric has appeared, with a sort of setbacks between buildings that obscure sunlight and natural ventilation from entering the internal spaces. This leap of transformation has brought environmental problems that began grabbing the attention of architects and researchers, coinciding with the global interest in environmental aspects.

### **3. HOUSING EMERGENCY AND EARTHEN BUILDINGS IN PALESTINE**

Palestine has a slightly different context from other countries, at the time Palestine is facing setbacks in the political and economic spheres due the occupation, where Palestinians do not have the control of their natural resources, or the ability to use urban expansion regions for the future development. Accordingly, as in the rest of the world countries, there is a crucial need to rethink of the building sector in order to decrease the financial problems, focusing on two main issues: finding alternative viable and low cost resources of construction materials (such as earth), and to exploit the passive solutions in architectural design to decrease the financial problems, and to revive socio-cultural ties within the society. In both of these issues, the reference to the vernacular heritage is a strategic bracing, due to its deep relationships with

the specific features in each site.

The most emergence zone for housing is Gaza Strip, due to the consequences of the well known political situation. Depending on the Palestinian national early recovery and reconstruction plan for Gaza [8], in the attacks of 2014, nearly 10,000 housing units were damaged totally, severe damage to nearly 10,000 housing units, and partial damage to nearly 40,000 housing units. Those numbers are very large in comparison to the total number of families there (about 220,000 families), which means about 60,000 families became homeless. Entire neighbourhoods still lie in rubble; residents cannot rebuild their houses. At the same time, people are not allowed to import building materials from outside Gaza.

Despite all, some individual efforts of innovation can be observed there, following the necessity to shelter people; some organizations offered the homeless families by a sort of containers to live in, but they were not suitable enough to their basic needs of living, it was just a temporary solution. Some individual efforts of wooden constructed houses, and other important efforts are about reviving the earth as a building material. Coinciding with the lack of construction materials, additional 71,000 housing units are needed for Gazans in 2020 [9], to fit the population growth, which increases the problem of providing people by suitable houses, and gives a raise to the need for rethinking of sustainable alternatives.

The siege of Gaza has made the construction and reconstruction works impossible, since the embargo includes the steel and cement, beside several important materials. The siege has led some Gazans to construct new earthen houses to shelter themselves, by using the compressed earthen bricks, which were produced from soil excavations. According to the Earthen Architecture Database ([www.eartharchitecture.org](http://www.eartharchitecture.org)), previous attempts to increase the use of earth as an alternative sustainable material in Gaza, were started in 2008 by the UN as a first phase of the project called for the construction of 120 houses, each house costs approximately 8,000-10,000 Euros. The project were funded from Kuwait and the Red Crescent Society of the United Arab Emirates, it also included a training of the workers to make the earthen bricks from local materials, using an ancient technique, wooden windows frames, and domed roofs that does not require steel. These attempts were successful, and possible for the society use due to the availabilities of materials and techniques. More attention has to be paid by other governmental and non-governmental organizations to improve and increase the use of earth in Gaza, which at least helps to some extent in solving the problem of homelessness. Furthermore, an encouragement of the community to reuse earth has to take a place in this issue.

#### **4. THE ADDED SIGNIFICANCES OF EARTHEN SUSTAINABLE BUILDINGS**

Using earth as an alternative material towards sustainable development of houses in Palestine, can be a starting point that has a potential to discuss the possibilities and extents of using earth in three technical solutions; A) refurbishing the envelopes of partially destroyed buildings in the post-war periods, by adding a new earthen envelopes instead of the damaged ones, within buildings where the possibility to take advantage of the previous structures, after evaluating their structural capacity. The new earthen envelope can be attached directly to the existing envelope. B) using new earthen envelopes as an additional external layer for the existing buildings those were not designed to be thermally efficient in different regions of



Palestine, where it is appropriate, by adding the new layer on a certain distance from the existing one to create a ‘social transitional space’, to add social, economic and environmental values to the building itself. C) constructing new earthen buildings, where the benefits of passive solar solutions can be taken into consideration, using well-treated earth to stay as long period as possible. These presumed solutions need a deep empirical work to think of the technical issues such as the feasibility of matching two types of materials, taking into account the thermal expansion and contraction, and considering technical issues related to the maintenance and – above all – the resistance to the atmospheric agents.

Earth adds to the building many environmental values due to its high thermal insulation, the fire resistance, the sound insulation, also its high local availability in Palestine as referring to the analysis and studies carried out by different researchers [10, 11]. Earth can be made in different shapes, colours, or sizes. In addition, it can be compressed and reinforced by fibres, husks, or straw during the production of the mixtures, to achieve the suitable strength, beside the possibility of mixing a moisture resistant within earth production, to fit the climatic and seasonal changes.

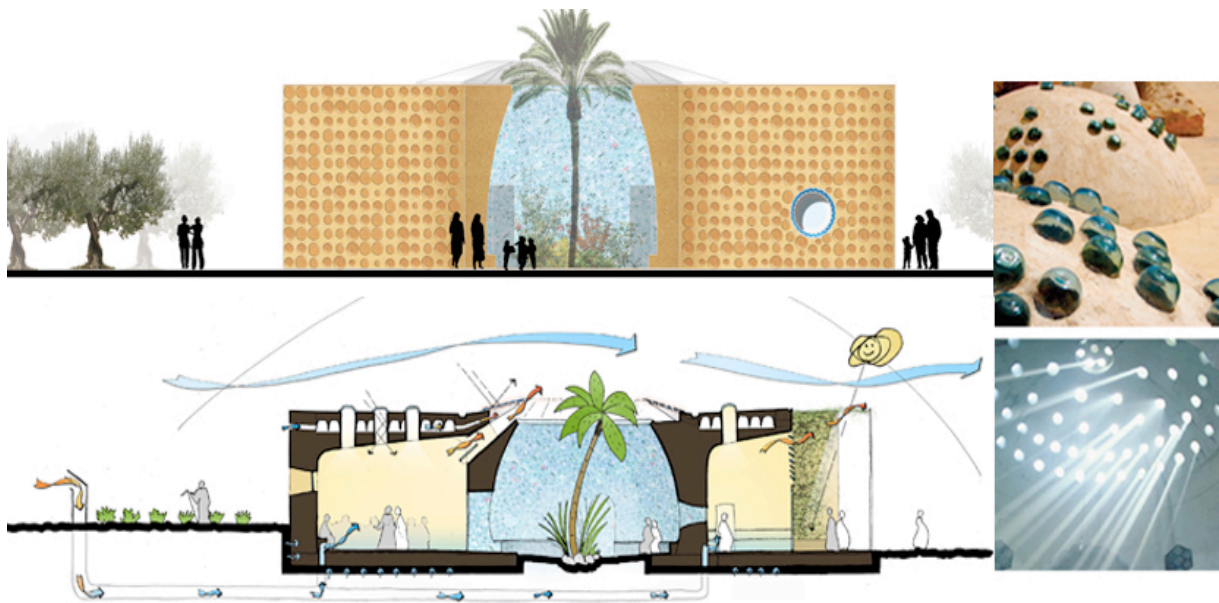


Figure 3. Concept for earthen building, Aqrabaniya Women Centre, Palestine  
[UNESCO Ramallah Office & Building Green Features in Bologna- Italy].

Contemporary and future earth constructions should take the advantages of traditional passive solar solutions. A good lesson can be drawn from the *Mashrabiya* as an example of perforated traditional element within the buildings envelopes. It was used for different functions to enhance the building responsiveness to the local environment and to the community needs. There were many other examples of traditional responsive models; those were used to provide shadow, to control the light passage, to facilitate the natural ventilation, and to keep indoor temperatures stationary during the summer and winter as a method of achieving thermal balance. These environmental elements can be improved, developed, and applied, to all proposed dimensions; in the recovery of buildings or in new implementations. A good

example of contemporary earthen buildings has been implemented recently in Palestine by UNESCO, the concept was about re-employing the traditional perforated domes, to benefit from the indirect lighting, and decreasing thermal transmittance, and to keep the internal spaces cool without the resort to mechanical air conditioning systems (Fig. 3).

#### **4.1. The social added significance of earth construction**

The traditional architecture and the traditional urban fabrics have played a successful role in the matter of social connectivity within the old communities. The adjacent houses occupants acquired their social communication indirectly by making types of perforated elements within the building envelope, such as *Mashrabiya*, which maintained the privacy for the house occupants as an important issue within the conservative culture. At the same time, the occupants came into contact with outsiders or neighbours easily and effectively.

Palestine has a conservative community, while privacy and social interaction have been neglected in the recent designs and implementations. The privacy level is determined in a house by the window size (it is mostly closed by a blind or solid shutter, which affects the ventilation process). Children, women, or old people in the same neighbourhood have no great contact as before. Hence, here the study discusses the extent to which the new earthen envelopes can be designed to re-fit the social values. There is a chance to design new sustainable envelopes, re-connecting the community, and adding the identity. The house design should not be limited to the repeated window shapes and sizes, which are not well-oriented. There is a possibility to produce a new sort of social spaces locating them between the old and the new added earthen envelopes within the same building. A specific width can be decided, and an external perforation pattern can be made into the earthen envelope, to provide a social living space for the family. In addition, the earth techniques are intrinsically endowed with added social value, when they consider the collective public participation in the construction process.

#### **4.2. The economic added significance of earth construction**

As the earth is a cheap construction material, it can give an economic potential in the future innovative methods and improvements, to revive the spirit of cultural heritage, using earth features. In addition, the possibility to refurbish the partially destroyed houses in emergence cases by adding new earth envelopes will help in decreasing the costs of constructing the structure, due to the existence of the previous concrete structures. Above all, a decrease in the running cost can take its place after adding the earthen envelopes due to its thermal efficiency in decreasing heat gain and heat losses. When talking about other alternative materials for refurbishment such as cement, steel, wood, or other materials, many challenges will appear, such as the acute shortage of these material due to the siege on import in Palestine, beside that these materials are generally expensive in Palestine in regards to the average income level of citizens. Moreover, the stone fining and construction techniques are also expensive, beside the high running costs of heating and cooling of houses due to the non-use of thermal insulation. In addition to all, and according to the Palestinian per capita income, the cost of creating a house is over the ability of Palestinian persons those have middle-income levels, but how are the cases of persons with limited income level? Depending on Shewaka [12], an 80 m<sup>2</sup> house

made of cement would cost around 16000\$ at least, but earthen house made from local materials, of the same area, costs just 3000\$. However, the earth material has a great economic potential to be circulated into the Palestinian context in different categories of use.

From an operating perspective in the refurbishment proposals, the question of the technical compatibility of the new earthen envelope in an existing armed concrete frame arises strongly. Carefully detailed designs and experimental implementations must be developed to evaluate the feasibility of this vision.

## **5. CONCLUSION AND RECOMMENDATIONS**

The economic and environmental deteriorations, the energy depletion, the population explosion, the reap of progress crumbs, have led recently to a great emergence of votes to save the human, the environment, and the nature as the components of life. Another side of the world has additional problems related to poverty, homelessness, social segregation, etc. These emergencies require a turning point, a new cultural approach. There is no need of technological innovations or high cost inventions, but a new human, social, and economical point must to be considered.

Nowadays, the living sphere, including buildings and the surrounding environment, is facing several challenges related to the use of construction technologies, and finding sustainable alternatives. Earthen building techniques play a good role in this issue, as they retain a group of potentials and advantages for sustainable development in architecture. Earth has the aptitude to be used as self-construction material, which reduces the construction costs beside the running costs of the house. Accordingly, architects should play a great role to find more effective contemporary architecture, which fits the local contexts, to establish a better trend for the future in line with reality. The architects future contributions are expected to respect the values and features of the context they are working for, which doesn't mean just laying down the roots in the history or in the modernity without respecting the environment and the temporal requirements, this vision has been emphasized in many studies [13, 14].

The recent local, regional, or global attempts of earthen revival have resulted in several suggestions on the levels of building techniques, improving earthen mixtures, or enhancing passive solar designs, in a whole vision of the building and its surroundings. Some architects started to understand the importance of achieving the sustainability principles in their works. Following these points, the earth marketing is an important factor, the industry of earthen architecture became familiar to some extent, this can open a door for further attempts in the future to increase the earth industry and improve the quality of the earthen bricks that fit the climatic considerations.

This study highlighted different dimensions where earth can be used in the Palestinian context, but it could be used similarly in other contexts of the world with similar circumstances. The study leads to a comprehensive understanding of earthen architecture situation in Palestine, and the alternatives for sustainable development of earth starting by the product improvements, to the merging of the reality in contributions, and confidence deeply in solving environmental problems of the Present and Future, as one of the urgent problems. From this point of view, a group of recommendations are highlighted in the follows, to be

taken into consideration by architects, organizations, or the governments, in order to plan, to control, and to develop the reality:

- The principles and the work methodology of earthen architecture have to take their place in the recovery plan of Gaza and other similar emergency cases in the world, as the earth has many values and advantages.
- Refurbishment of the existing houses to fit the sustainability principles is crucial; the earth has the potential to be used in this setting.
- Perforation of earthen envelopes as a passive design technique, has many environmental, cultural, and social values; it could play a good role in the concepts of refurbishing the houses envelopes, in both of the mentioned categories.
- The orientation of the new added earthen envelopes to a house must be carefully determined regarding the climate and the site features, to take use of sunlight, natural ventilation, shade, etc.
- An extended empirical work have to take its place in the future to check the operating perspective, the technical compatibility of the new earthen envelope in an existing armed concrete frame. Institutions and organizations can do experimental implementations to evaluate the feasibility of this vision to be developed in the future.
- The governmental institutions have to economically encourage families to refurbish their own houses, and also technically by generalizing earth construction techniques, mixing methods, and advanced models of earthen houses.
- As a part of public awareness, the local communities should be learnt through their direct involvements in the developmental projects, that the idea of living in an earthen house is not a shame; on the contrary, it is a global contemporary trend that can have the modernity forms, in addition to the identity and other important values.

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