

**Earthen architecture & sustainable building:
Proposed union between authenticity and technical renovation
- Case of south moroccan villages -**

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Abstract Summary:

In this paper, the two-edged nature of earthen architecture is explored: Its Styles' Authenticity and its Sustainable Nature. In the southern area of Morocco as well as in several villages in the world, such kind of traditional buildings reflect the image of the ontological "truth" of some nations' architecture in need of salvation. In addition, those earthen buildings possess a high environmental quality which we would promote. Testing the validity of the hypothesis goes through two stages: The first stage is to explain the aspects of authenticity in the lifestyle generated by that architectural style; the second stage describes the characteristics of the materials that respect pertinently the environment. The purpose is to promote a sustainable re-creation of an architectural heritage that is basically sensitive to the environment.

Keywords: Earthen Architecture; Sustainable Traditionnal Building; Re-creation of Identity; Re-creation of Earthen Technicality.

1. Introduction:

Earthen material is one of the most common elements of the planet, the most available, the most inexhaustible, the most versatile, the least expensive, and the least harmful to the environment. This material builds, at least partially, the houses of more than a third of the World inhabitants. Twenty per cent of these area's homes are representing the UNESCO cultural sites and are mentioned in the world's heritage list. [1]

In today's world, such earthen constructions are the first to be razed and replaced by a generalized type that neither respects the diversity of cultures nor the originality of the material. The tendency to opt for modern sustainable architecture often overlooks the validity of earthen methods despite their several environmental qualities.



In the same context and between 1900 and 1989, the Egyptian architect Hassan FATHY has actively introduced the concept of "to build for oneself". He especially encouraged poor Egyptian families to develop construction techniques from earth in order to keep the authenticity of their villages. In addition, he has revived this construction through the implementation of new projects fully built from earth. [2]

In Morocco, many international attempts were engaged to save earthen structures in some distant villages [3]. These attempts have aimed to restore this heritage, while the real need for us is the re - adaptation of earthen architecture as a building system which is worthful. Then the biggest challenge in this research is to find how can we dually protect the architectural patrimony and build sustainably? How can we make use of new tools to construct buildings of ancient style? How is it possible to adapt "earthen architecture" to be fairly sustainable? And how can we take advantage of traditional architecture to make similar buildings that are actually authentic and durable enough?

Analyzing the double value of earthen architecture in a specific context -which is Moroccan community-, will link two important topics that are rarely connected by researchers: the earthen architecture's role in preserving the community's identity and the technical ingenuity of the earth as a sustainable building material.

2. Methodology

2.1. method and tools:

This research adopts a set of analytical tools conducive to the study objectives. The research method is divided into two main components:

- a - Analysis of the ideological component:
 - Understanding the architectural concept of the mud house in Morocco (Life-style);
 - Explaining authenticity foundations of the community;
 - Identifying problems related to ideology in the modern context;
 - Reviewing the functional and formal image of earth houses.
- b - Analysis of the technical component:
 - Understanding the architectural concept of the mud house in Morocco (HQE);
 - Understanding traditional earth construction techniques;
 - Identifying the technical problems of the earth material as a sustainable option;
 - Reviewing the appropriateness of the earth as building material in sustainable scenario.

2.2. Scope and limitation:

To delineate areas of analytical intervention and to focus on the main points of this research, all theoretical (a) and technical (b) components of earthen architecture were sorted. The analysis focuses predominantly on the most significant aspects of our topic. *(Figure1)*

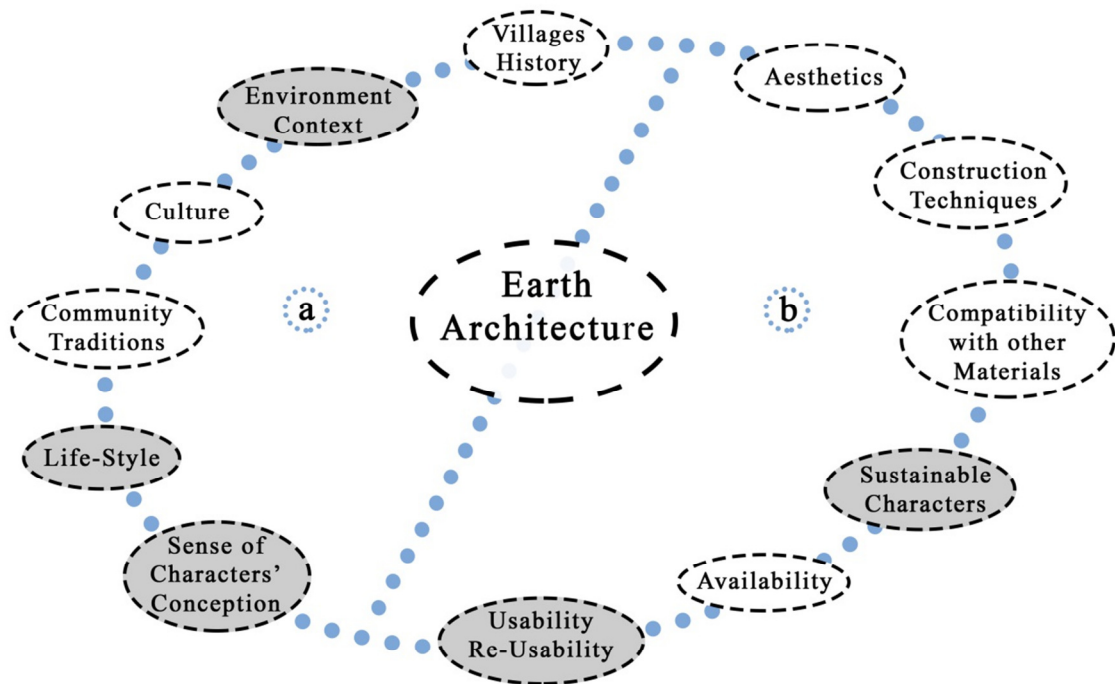


Figure 1: Sorting of theoretical (a) and technical (b) components of earth architecture, and selection of main aspects for the topic (grey areas).

3. Results and Discussion

3.1. Ideology and Authenticity :

Moroccan earth villages have been initially built by the communities that have been settled since many decades in large buildings as a "Qsser" (earthen compound enclosing houses of one big family and their servants). The choice of the location is based mainly on the water criterion (*Figure2*). Thus, we find that most of these villages are settled in a given oasis near valleys. Consequently, these conditions promote accessibility to a good earth material to build their homes. In addition to water, we quickly feel a sense of orientation to the prevailing winds as compared to large set of blocks that respects the opposing fronts and offers each habitat unit a clear view to the landscape. The second criterion for this choice was to insure security against attacks from enemies and thieves at that time. Thus villages were located in high positions in order to keep an overview of all directions. (*Figure 3*)

The environmental context of these villages is in perfect harmony with the landscape. It has a very strong concept of "living in earth" which is environmentally better than any other modern methods of construction. In this way, earthen architecture validates already the eco-construction target of the sustainable architecture (HQE).



Figure 2: *Personal Photo, oasis and valley of Douar Tamnougelt, Ouarzazat, Morocco.*



Figure 3: *Personal Photo, Qsser Ait Benhaddou, Ouarzazat, Morocco.*

The location of these villages mentioned above is also in accordance with the mentality, culture, traditions and primarily with the religion that is Islam. This belief has always been a faith and a code of life: something that guides a specific life-style that we can easily read outside and inside houses. The founding principles (constants) of earthen architecture in Morocco were basically derived from Islamic concepts:

- Privacy / Modesty: Narrow streets that enhance the private space as well as a sleek exterior with the principle of an inward opening on central patios which represent “the outside into the inside”. (*Figure 4*) and (*Figure 5*)

- Union / Centrality: All houses are built one next to another in gathering spaces with a minimum of space connection and next to central points that represent functional landmarks like the mosque or the well.

- Spontaneity / Respect: Basically, the village traces only its limits and boundaries, while all residential units multiply spontaneously according to community rules and within a total neighborhood respect.

The authenticity of this architecture remains in perfect harmony between a belief (based on the principles of unity and modesty) and urban- architectural practices (that accurately reflect the ideological needs of the people). As such, it is a real sustainability in terms of architectural style as well as of community life.

The non-consideration of authenticity influences directly people attitudes (Space makes Human as well as Human makes Space). Commonly perceived as only a vernacular form of architecture, earthen construction has seen increasing standardization and industrialization in recent decades. Consequently that current modernization overlooks the meaning of concepts and causes many mutations in the "Muslim" space; the technicality takes priority and modern manufacturers do insert the same blocks with the same materials and the same designs in the whole world. It is an act of killing the multi-diversity; an act of killing the inherited “sustainable”.



Figure 4: Personal sketch, back street in Douar Tamnougelt, Ouarzazat, Morocco.



Figure 5: Personal sketch, chicane entrance of a house, Douar Tamnougelt, Ouarzazat, Morocco.

3.2. Technical characters and Sustainability:

Significant efforts have been made over last years in developing earthen architecture through preservation measures. This progress could be inter- linked in many ways to the approach of reintroducing earthen construction as a sustainable building; the continuity of the tradition of building with earth facilitates conservation practice and legacy, while promoting this important architectural technicality inspires its future use.

Indeed, the demonstration of the qualities of earthen architecture in the view of the “HQE” is quite possible. Technically and concerning the urban plan, the compactness of earthen village houses has ideally the requirement of reducing Form Factor (CF) (or shape coefficient) which is one of the foundations of an effective eco-design, and which is necessary for reducing the heat losses in the building. Then, there is a central open patio that acts as a skylight, as a thermal regulator, and which also ensures great ventilation for all interior spaces. [4]*

In addition to the design quality of this style of architecture, mud walls grant soundproofing, struggle against heat losses and provides great inertia that absorbs peak temperature, then, stabilizes ambiances and gives real comfort even in bad climatic site conditions.

This 100% recyclable material is a renewable resource with a big potential to be reused without limits. Likewise, the earth is therapeutic, because it treats infections of the skin and kills bacteria and mites. In addition, it is worth mentioning that an earthen construction uses only 3 % of the energy used in modern construction. In all its forms, it has no direct role in water consumption during the life-cycle of the building, as it has no unhealthy nuisance on work site. Recent research has also shown that it can be mixed with several new materials likely to improve and resolve its probable defects (such as low resistance to rain, earthquake, and thermal bridges).

Very quickly, we realize that the problem of thermal bridges - which is a general problem - can easily be treated for a low cost. Similarly, resistance to rain can be achieved through additives or via a periodical maintenance done by the inhabitants themselves. As to earthquakes (that is not a particular issue in Morocco), studies show the opposite: The earth material alone, is not an excellent material against great earthquakes because it is not a high pressure resistant material. It has however many high mechanical properties such as a certain deformability under compressive stress and shear. Consequently, earth becomes an interesting earthquake material. Practically, if we want to build in the ground in seismic regions, it is possible to combine it with another material resistant to tension like wood. [5]

Timidly supported to face the global economic challenges, the earth material with its various forms and techniques is an excellent sustainable material that respects the environment and provides a strong aesthetic that is fading out bit by bit.



Figure 6: Personal Photo, façade of a private house, Ouarzazat, Morocco.



Figure 7: Personal Photo, traditional ceiling, private house, Ouarzazat, Morocco.

4. Conclusion

“Governmental authorities frequently consider earthen construction to be substandard, even though it may meet the housing needs of the population more appropriately than other building materials and techniques.” [6]



Nevertheless, adaptation and improvement of the earthen building is simultaneously a double action which consists of “building with the local populace” and “building for oneself”. This approach will show the degree to which some traditional cultures are historically sensitive to the environment and particularly technically ingenious in spite of the simplistic building’s tools in their possession. Ideologically deep and encrypted via social codes, this earthen cultural tradition of ‘living’ and ‘building’ gives “green standards” a new dimension.

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* Shape Coefficient (SC or Cf = Coefficient de Forme) = Ratio between the exterior area of the envelope and the volume of space whom it contains.

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