

2nd Cyprus International Conference on Educational Research, (CY-ICER 2013)

Earth Architecture from Ancient until Today

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Abstract

Earth Architecture is a study devoted to the architectural uses of earth in shaping the environment of humankind, a subject closely related to human ecology. Earth Architecture includes contemporary as well as historical and vernacular examples drawn from many cultures and periods. Structural built of earth presently house an estimated 1.5 billion people about 30 percent of the world's population (Keefe 2005). Archaeologists have found evidence of mud brick buildings constructed as early as ten thousand years ago in the Middle East and North Africa, where impressive buildings up to ten stories high have been recorded in an unbroken architectural tradition that continuous today. Although creating individual earth structures is a familiar practice in many areas of the world today, the practice of reshaping the earth to create new human environments is little known. The current paper is a review on earth architecture from ancient until today!

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Selection and/or peer-review under responsibility of Prof. Dr. Huseyin Uzunboylu, Near East University, Faculty of Education, Cyprus

Keywords: Earth architecture, mud architecture, ancient, modern;

1. History of Earth Architecture and Earth Construction

Deliberately planned and built shelters began around the same time around the world. Even in those times, similar to the present scenario, development involved many levels based on the social evolution stage. These beginnings take us back to the earliest archaeological findings,; however, only the virtually indestructible stone tools are remaining. During those times, humans were constantly on the move, following the hunting and gathering patterns as dictated by the region in which they lived. Because of this migratory nature, the possibility of a fixed dwelling place was completely out of question. As their

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hunting and gathering patterns were refined, humans repeatedly visited the same desirable locations such as caves and cliff sites, with proximity to food and water. The earliest-known shelters that used Earth were outgrowths of temporary, seasonal shelters that were made of wood and brush and were usually covered with mud for waterproofing. This type of construction is commonly known as "Facal". A lot of activities during those times took place outside and people would use shelters only during the most inclement weather. Some physical features rendered to such shelters were primarily for security reasons from animals and hostile neighbors. The possibility of obtaining and making use of larger structural elements was based on inventing tools to develop those structural elements. Very few tools in addition to sharp stones, a pointed stick and the builder's hands were available. Some means of carrying water to the construction site were also needed. As the importance of agriculture and its knowledge in humans increased, there increased a need to move away from the hunter-gatherer phase to the more intensive cultivation of fixed locations; thus, an increase in the requirements for shelter. Thus, the first form of shelter that developed was partly underground creating a cave; a structure that was known. These first shelters were called pit houses. This pit house was, for the time, appropriate in terms of environmental design, appropriate technology and labor economy. It used materials close at hand, required little planning or preparation of the materials to be used. Various wall-building techniques were employed construct pit houses, including pudding of mud, lumps of mud and a rudimentary type of brick formed in baskets. This construction was called turtle construction because of the type of materials it used. The pit house shelters used by Hohokam irrigation farmers in the South-Western United States (100-900 A.D.) were so successful that they remained unchanged for more than 600 years. A lot of features from these pit houses are rediscovered today in the form of termed collecting the sun warmth on protected south slopes. Because civilizations developed independently in different parts of the world and progressed at different speeds too, establishing a firm chronologic order for specific stages of development on a global basis becomes impossible. In fact, similar construction stages often occurred centuries or even millenniums apart in different parts of the world. Variations in the form and selection of materials were based on the local environment. Stones were used at places where they were readily available; while at other places, wood and other organic materials were used because they were more abundant. However, in both the cases, the use of Earth was necessary to make the best possible use of the other material and fix it firmly to form the structure. Places where neither wood nor stones were available, mud were used alone. Even today, these three basic techniques are being used in developing Third World countries. Modern industrial countries, on the other hand, use these basic techniques more often in rural locations. The development of the (adobe) brick, a performed modular masonry unit of sun-dried mud, came into existence with higher civilization levels. In those days too, the leisure time of the householder was used in selecting the material and the architecture to build the structure, which led to the construction of monumental domes for religious and public buildings. Crude forms of construction often existed side by side with the complex ones then, as they do today.

The use of preformed bricks began when the need for a more efficient, rapid construction technique came into existence. This need for change was identified because drying puffed and shaped mud walls took a very long time. Early forms of this type of construction, called turtle wall construction, occurred in the South-Western United States. In this form, mud was placed in a basket with a round bottom and either placed on the ground to dry or laid directly up on the wall where it could dry. Another brick type common in many areas was cut sod bricks. The Spanish name for this is Terrone. These bricks can be procured only in swampy, boggy river bottomlands. They are cut with a shovel from soil having a heavy grass root structure or mat, placed on edge until dry and then used as bricks to build tough, long-lasting walls. The use of bricks in more complex construction forms also must presume preplanning and some standard of measurement, perhaps the builder's own measuring stick or "rule".

Egyptian structures from 2500 BC show a high degree of sophistication. Many surviving measurement tools and surveying, engineering techniques substantiate this fact. Wall murals indicate the production techniques of adobe bricks and biblical references a specialization of tasks, where Jews were assigned the task of making bricks. The use of straw and its supply are also noted in some other parts of Egypt. In the Middle East, millenniums of civilization and population pressures created new demands for land and settlements in harsher arid environments. Techniques that required no structural elements at all were developed, and buildings were built entirely of mud brick. The masonry vaulted forms, presumably developed in the Middle East before the Egyptian Dynastic Period, spread to North Africa and then Roman cities. Later, Moorish invasions spread these construction forms in Spain. In fact, they were exported to the Western Hemisphere by Spanish explorers. In the South-West Spain, explorers found mud villages dated back in 1540. Settlers from as early as 1590 brought adobe technology from the South, into an area with a long history of Earth construction. Their use of adobe bricks, not known to the Pueblo Indians except in rudimentary forms, was to set high levels of standard for many centuries. The economic and transportation systems in that time made using locally available materials mandatory. The rapid westward expansion of the United States made wide use of this material, not only in the arid Southwest but also in all Western states. Local building suppliers provided “bricks “for sale along with lubber and quick lime all produced locally. In general, settlers followed the local customs and traditions using rocks, logs and mud, depending on the local conditions and availability. On the Eastern Seaboard, in many locations including South Carolina, New York and Washington, D.C., rammed Earth was used in the mid 19th century. A treatise was published in 1839 extolling the virtues of rammed Earth construction. It is a variable medium in virtually any climate and does not require the curing time without rain necessary in the production of adobe bricks. With the advent of railroads pushing west in the 1880s, manufactured materials previously unavailable were in abundant supply. Thus, homeowners, builders and merchants strived to upgrade building materials and emulate the styles of the East. As this pressure increased, the use of adobe bricks gradually declined. In spite of this trend, the use of adobe bricks in rural situations, and for economy in many commercial buildings, still persisted.

The great depression in the 1930s resulted in rediscovering this material and sparked a short-term interest with some oil companies sponsoring research and product development of stabilized adobe bricks. Asphalt emulsion was used as the stabilizing agent. However, the oil companies abandoned this effort in late 1940s. A number of public buildings were built during the 1930s, and at least one school was built using adobe bricks in New Mexico in as late as 1940. Some architectural styles were in the traditional southwestern Pueblo on Territorial style, but many were of conventional styles, where the adobe brick was meterly another type of common brick that was economical and available. During the time between 1940 and World War II, there was a decrease in the use of Earth for building. Most construction in this medium was limited to either residential construction of large luxury homes where the owner could afford to indulge the nostalgia of Spanish Colonial styles, or to the very poor that had no other choice and were limited to what they could produce with their own hands. Thus, a split image was created, that adobe was for either the very rich or for the very poor, with little acceptance in between. In the relative absence from the scene for a whole generation of architects, engineers, building officials, and builders using earth construction, the experience became lost. Changing economic conditions and shortage of energy must lead to a new evaluation of this historic buisling material. Only 20 years agon, adobe construction was dismissed as impartial or undesirable, because of the belief that it could be used by the very rich or the very poor. However, today, it is taken seriously and accepted as a logical building medium. It must again assume its place as an important, energy efficient building material.

2. Conclusion

The current paper is shown a review on earth architecture from ancient until today. It has shown the earth buildings are contemporary as well as historical and vernacular examples drawn from many cultures and periods. Structural built of earth presently house an estimated 1.5 billion people about 30 percent of the world's population. Archaeologists have found evidence of mud brick buildings constructed as early as ten thousand years ago in the Middle East and North Africa, where impressive buildings up to ten stories high have been recorded in an unbroken architectural tradition that continuous today.

References

- Middleton, G. F. (1975). Build your own house of earth compendium Pty Ltd. Mentone, *Victoria*, Australia.
- Frank, R. Walker, Ed. (1954). The building estimator's reference book, 12th ed., *Frank R. Walker, Publisher Chicago*.
- McHenry, P. G. (1984). Adobe and rammed earth buildings, *John Wiley and Sons*.
- Rael, R. (2009). Earth Architecture, *Princeton Architectural Press*, New York, USA.
- Morgan, W. N. (2008). Earth architecture from ancient to modern, *University Press of Florida*, USA.
- Niroumand, H., Zain, M.F.M., Jamil, M. (2011), Hill development by Earth architecture. *International Journal of Physical Sciences*, 6 (6), 1249-1256
- Niroumand, H. (2011), Nanotechnology in Architecture. *Academic Publishing*, Germany
- Niroumand, H., Zain, M.F.M., Jamil, M. (2012), *Advanced Materials Research*. 457-458, 354-357
- Niroumand, H., Zain, M.F.M., Jamil, M. (2012), *Advanced Materials Research*. 457-458, 395-398
- Niroumand, H., Zain, M.F.M., Jamil, M. (2012), *Advanced Materials Research*. 457-458, 403-406
- Niroumand, H., Zain, M.F.M., Jamil, M. (2012), *Advanced Materials Research*. 457-458, 399-402