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RESEARCH ARTICLE

EARTH CONSTRICTION AND ENERGY

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ABSTRACT

The traditional structures were built with natural materials such as stone and earth that provide healthy indoors, concerning the climatic conditions. The developing in the technology gained momentum after industrial revolution in all sectors as well as in the construction industry; resulting to give the importance to stones and natural materials. Lot of energy is being used to provide comfortable life inside building even the changing of temperatures according to climate. Recently the energy has gained special importance after the increasing of cost fuel oil and electricity. The most part of energy has been used in residential and industrial fields.

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INTRODUCTION

"Sustainability is development that meets the needs of the present without compromising the ability of the future for meeting their necessities" (United Nations, 1987). There are needs for developing the liveable world and present it to next generation. Sustainability comes into prominence from industrial revolution and has increased since the beginning of century. Sustainability depends on the maintenance of the natural world and natural resources. Reducing the energy consumption in the construction and the life cycle of construction will take important role in the sustainability. Earth construction has some disadvantages properties like the lack of strength against the external effects and lateral forces. Stabilization with gypsum and lime stabilization was used in 9000 BC. (Kafesçioğlu and Güldal, 1985) The Alker has used since 1980 for providing the durability. This new composite material with low shrinkage value is suitable to provide advantage for the construction sector. The aim of this study is using the Alker to get sustainable construction with less energy consumption. The study concerns with stabilization the soil for restoration new buildings. The using Alker with soil provide more strength and more resistance of materials. This study showed that the properties of soil will be more efficiently for construction.

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Earth Buildings in the History

Earth building as an architectural technique has a very long history. Earthen buildings has been used throughout all the world`s ancient civilization, from Mesopotamia to China (Ronald and Rael, 2008) and from Mediterranean to America, in the mankind history. Earth architecture has responded to the different climates with knowledge, accumulated throughout the history.

A.Earthen BuildingsAroundthe World

Earth houses are commonly used in the entire world; the 33% of population live in earth building houses (Ronald and Rael, 2008). Nowadays the curriculum does not include earth construction as subjects in engineering and architectural studies but it includes the concrete construction widely. The demand of earth houses hasincreased gradually because the health and energy which are essential for sustainable buildings. For instance, in USA people mostly prefers to live in earthen houses. In France around 15 %of the population lives in earth-walled houses (Minke, 2006;Hill, 1949; http://www.mapsworldwide.com/maps/cyprus_map.gif; http://kktcmeteor.org/meteorolojik bilgi/kıbrıs-iklimi.aspx; Salihoğlu, 2008).

As example, the earth house was constructed in Mediterranean region for a long period of history. During the summer month (July-August) the temperature ranges between 24^0 and40^0Cand

there are 12h of sunlight per day. During the winter month (January-February), temperatures range from 9 to 12^0 C. The average precipitation is 397.6mm/y, the average sunlight hours are 5h/day. The weather under these circumstances the consumption of energy would be more significant in cooling and heating (Ozbekoğlu, 2008; Aktaç, 2008; Holtzhausen, 2007).

B. Advantages of Earth Building

The advantages of earth buildings are being healthy, less energy consumer, less casualty in natural disaster like earthquake. However the essential of material is very cheap and can be existed in everywhere. Earth structures generally use the locally available materials which are recyclable. The use of earth for the built environment would be continued as a strong component in the future (Criss, 2005). For instance one block with 25.4X10.16X35.56 has approximately 93 MegaJ/m^3 embodied energy (Middendorf, 2001). This value is very low comparing to other construction materials.

Table 1. Curing of Alker

Traditional earth construction	Alker construction
15-21 days strengthing	20 min. strengthing
curing area	no curing area
water sprinkling	no water sprinkling
rain protection	no rain protection

Table 2. Alker Production Process

mixer + earth + 2 kg water	2 minutes mechanical mixing
barrow + water 18 kg + lime 2 kg + gypsum 10 kg	2 minutes hand mixing
pour the barrow full of mixture into the mixer (water 18 kg + lime 2 kg + gypsum 10 kg)	3 minutes mixing
pour the mixture to the wheel borrow; ramm it into the wall form	in no longer than 15 minutes

Table 3. Physical properties of Alker

Unit weight	1.6-1.7 kg/lt
Shrinkage	1.0-1.5%
Compressive strength	2.0-4.0 N/mm^2
Shear strength	0.9-1.3 N/mm^2
Water absorbtion	very low
Long term water exposure (except direct rainfall)	no erosion
Heat transfer value λ	0.4-0.5 kcal/mhC
Specific calorific	1.0 kJ/kgK

C. Low Heat Transformation

Stabilization of soil with gypsum has porous structure. The porous composite has low heat transfer value comparing with contemporary earth materials this may be main ecological benefit of earth house. Thermal comfort is tested when the thermal processes within the human body are in equilibrium when the body manages its regulation with minimum of effort and the heat which dissipated from the body corresponds with equilibrium by losing the heat to the environment (Mchenry, 1989).

D.The Renewable Materials

Renewable materials mean of being with economic and environmental value which can be replaced in the same amount. Soil is a renewable material because it supplies through the natural decomposition cycle or could be readily recycled (Neufert, 2002; Işık and Tülbentci, 2008; Kafesçioglu *et al.,* 1980; Ravikumal and Prakash, 2001).

E.Low Fire Risk

There are no flammable in the earth materials compared with other construction materials, there are not any fear from burning or firing. The earth materials are safety against the fire.

F.Workability

The earth materials are suitable to get the shape by mould or by hand. So it can be shaped very easy. The production of shaped earth element could be carried out by intensive of labours. The shape of block clay is traditional in this field to get acceptable compressive strength. Another method is compaction method which is done by using the hammer. The plasticity of soil is highly for hand compaction. The compaction method needs lower workmanship to product the moulded earth bricks.

G.Earthquake Response

Earth structural elements are vulnerable against the natural phenomena such as earthquake, rain and floods. The traditional earth elements which respond very poorly to ground shaking and might suffer serious damage or collapse resulting with more casualties but not as much as the casualties of collapsing of reinforced concrete buildings. This may be disadvantage of earth building however the enhancing by using wooden frame in earth construction could be reduced (Wolkoff and Kjaergaar, 2007; Anne, 2007).

H.Improving Earth Building

Earth constrictions are the practice of building with unfired, untreated, raw earth. It has been successfully used around the world for over 11,000 years and it is estimated that around half the world's population who lives and in the earth buildings nowadays (http://folk.ntnu.no/fossumj/cpx/cardhouse2_e.htm).Earth is one of the most abundant basic materials. It does not need high technology and easily works with simple tools. It can be used by anyone who wants to construct walls; floors and shear wall. Earth building are highly durable, have good humidity regulation and sound insulation, and are non – toxic, non-allergenic and fireproof. The earth buildings provide excellent thermal mass and insulation when the thick walls by using the passive solar. It is clear that earth buildings have low

embodied energy and have ultimate sustainable energy. The aim of architect and engineer is to build well designed buildings. Well-designed buildings have three conditions: commodities, firmness and delight. These three conditions are timeless: commodity: the arrangement of plan unites to satisfy the social requirement; firmness: the disposition of structure to give shelter and stability; delight: the ability of combining firmness and commodity to give visual and sensual pleasure. At beginning of life on this globe the separation between human and beast was comparatively slight, and men and women lived in conditions similar to the animals. But a primitive desire for shelter soon arose caves probably formed earliest homes. Then the use of wood was discovered together with methods of cutting it. This led to primitive tent from in which boughs were leant against each other, bound at the apex and covered with brush and moss to keep out the weather. Later a simple post and lintel system was evolved by making use of natural materials. The Egyptian with their early civilization took this post and lintel stage further by discovery of new materials – stone and, to lesser and less successful extent, mud bricks. The factor of the natural materials like stone and bricks played very important role in to construct huge building like temples and prides which could resist all external effects and could be stood till these days. Finally it can be declared that how the old buildings like temples, bridges and historical arches could resist the natural disaster without falling even exposed to earthquakes in the past.

Conclusion

- The construction of earth houses are friend of environment since earth materials are healthy and never devastate the ecological principles which are necessary for getting sustainable constructions.
- The design of building by obtaining minimum cost because the earth materials are available in everywhere or it could be found in cheap cost.
- The materials of earth construction would be reused and evaluated by using them in infrastructures without spending much fortune.
- The earth building could reserves the positional energy which may be reduced by panel of the sun for a long time (Aljibouri, 1999, 2000 and 2007)

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