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Case study

Environmental impacts of adobe as a building material: The north cyprus traditional building case

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ABSTRACT

The urgency of global climate change has drawn significant attention to the building industry over the last few years. Today, the building sector is responsible for the emission of about 23–40% of the world greenhouse gases. This is plausible owing to the various non environmental friendly materials used by modern building industry and the palpable contemporary design construct. Unlike modern buildings, traditional building materials are proven to be earth conscious and have nearly zero carbon footprints. Yet, the modernist building sector with its insatiable drive for autonomy has relegated lessons from traditional building to being primitive. Moreover, the absence of objects of industrialisation has been defined as forming conformity with poverty.

Hence, this research seeks to scientifically examine Adobe as one of the traditional building materials. In that vein, the environmental impact of the use of adobe will be studied. The study also purports to adequately examine the advantages and disadvantages of the use of adobe in modern construction.

Methodologically, owing to the aims of this research, a qualitative computer based simulation approach is adopted. A typical traditional Adobe building in Louroujina—North Cyprus, will be simulated through a parametric computer based simulation done using Revit Architecture, with a green studio plug-in. Software acknowledge by the United State Department of Energy (DOE 2015). This simulation procedure models the carbon emission of the building and the yearly energy consumption.

Summarily, this paper posits that the successful fusion of traditional building materials such as Adobe and modern design construct will not only give birth to earth conscious building, but will also be energy efficient. Moreover, it will be a substitute building material the building industry can adopt at as a contributing solution to the omniscient global warming malady.

1. Introduction

The building sector today is known to be consuming 40% of the world energy [23] and in turn, supports 23–40% of the world's greenhouse gas emission, particularly CO_2 ([10], 18). This is plausible owing to the various industrial materials employed in the building construct. Taking a more panoptic review of this state, it will be realised that albeit the building

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material types engaged by the modern building sector, the hotchpotch design construct is yet, another causative factor for the palpable greenhouse gas emission.

Today, various methodologies are currently being adopted to look into this palpable condition. Stimulatingly, the international panel on climate change (IPCC) envisaged that the CO_2 emission from the construction sector could surge from 8.6 billion tonnes in the year 2004 to 15.6 billion in the year 2030. Under the speculated rising population growth circumstance as will be contributed by the developing countries.

On the paradox, traditional building materials have been proven overtime to be earth conscious [10,17,18]. Several building materials exist in the older building industry, because of the proximity, availability and geographical location. Such material includes mud bricks (adobe), stones, cobs and wood to mention a few. Summarily, the traditional building materials are stereotypically binary: earth related material and wood related.

Today, it is obvious civilisation is to be attaining its cusp; hence, there become a pressing need to take a panoptic look at the dictates of tradition before this technological era attains its cul-de-sac. Therefore, this research aims to examine adobe as a traditional building material. The environmental impact of the use of adobe in construction will be given holistic attention. Adobe traditional building in Louroujina village, North Cyprus will be the case. Primary data for the analysis will be collected by simulating the selected building. This is done through parametric simulations using the computer software- Revit Autodesk- with Green Studio Plug-in, a program which models the yearly carbon emission of the building. The secondary data are garnered from professionals' perspective, the ongoing Tubitak research project in Louroujina, books, journals, libraries and school data bases (Figs. 1 and 2).

2. Ontology of adobe material

Historically, earthen materials have been employed as building material for thousands of years of human existence ([13,14], 13). Adobe (Mud brick) houses dated back 6000 BC when discovered in Russian Turkestan ([16], 88). It was employed as the building material in almost all ancient cultures, not only for residential buildings, but also for public structures as well.

However, adobe is generally referred in different appellations. Scientifically, the term Adobe refers to a clay mix, silt (sand with finer aggregate), sand, and sometimes coarse aggregates such as gravel. To talk of the synthetic unbaked brick typology, terms “mud bricks ‘or “adobes’ are usually engaged. Describing the compressed unbaked bricks, the term ‘soil blocks’ is commonly used.

3. The global trend

According to Novel ([15], 63–85), not all traditional structures of the same types are found in similar locations. Generally, reasons for choice of material are often governed by several deciding factors and sometimes, by just one of them. Sometimes the quality and property of the soils in a particular geographical location affect the typology of building that will be palpable there. Therefore owing to the above preambles, it can be concluded that attempting to describe adobe buildings according to geographical is a task of such encyclopaedic scope. Hence, it is streamlined under the kind of material used by each continent. However, this can be achieved by graphically illustrating the globe, showing the typology of material used by each geographical location.

4. Thermal behaviour of adobe as thermal mass

By definition, according to [9], thermal mass refers to the capacity of a material to generally absorb and store up heat and subsequently release this heat when it is necessary. This allows excess heat to be absorbed during the summer, reducing the cooling loads and also reduce the heating load in winter. It is usually measured in the number of joules (J) of thermal energy

Fig. 1. Typical moulding technique of Adobe bricks ([13,14], 63).