Chapter 29
Earth Building Materials, Production, and Construction Techniques

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ABSTRACT

Building materials and construction technology are strongly interrelated with the pillars for sustainable development (e.g. environment, society economy, culture and politics). Earth Building, an 11,000-year-old practice of building using sustainable and earth materials, is practiced worldwide. Earth has been used to construct walls, floors, roofs, and even furniture. Today it is estimated that between 33-50%of the world's population is housed in earth homes. This chapter reviews the two-year process of earth buildings and earth architecture carried out by the Department of Architecture Faculty of Built Environment and Engineering at National University of Malaysia (UKM). The current research emphasis is on the types, construction methods, and architectural aspects of earth buildings and earth architecture. The current manuscript compares type of earth buildings and their properties and applications based on building materials and architectural aspects in construction.

ORGANIZATIONAL BACKGROUND

The sustainable development concept seems to be a promising approach toward global resource depletion and environmental pollution. From viewpoint of building materials and construction techniques, design to reduce pollution and resource consumptions plays a key role in sustainable developments whereas, satisfying demand and development as one part and keeping ecological environment as the other part are two critical issues that should keep balance. Innovation and improvement in building materials and construction methods to ameliorate

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sustainable development, Provide high quality of life for the occupants and users while reduction in environmental global and local impacts through conservation of energy and resources and protection of the site with economic benefits of low energy cost buildings take place (Hyde, 2008).

Based on the fundamental of sustainable development, building materials and construction technology should have specific characteristics to achieve the goals including the reduction in need of energy, design with sustainable and recyclable materials with continuous benefits of building materials as post-consumer resource and manipulating the widest possible renewable source of energy in sustainable design (Li 2011).

Building materials are known as the third largest group of CO_2 emitting in industry. Among building industry materials most of the amount of emitted CO_2 is produced by cement (Habert & Billard, 2010). Global warming is one of the consequences of increase in CO_2 level and influence the environmental, cultural, economic and social aspect of whole world. In parallel, Sustainable development in building materials suggest the application of one of the ancient building materials, Rammed earth, which is made up of sand, gravel and clay and water to form or mold. Rammed earth technology belong to China 2000 B.C. and is consider as one of the sustainable materials of the future design of buildings due to the presence of locally sourced Rammed earth materials and reduction the reliance on cement in building materials. This was an example regarding pros and cons of sustainable and industrial building material. Two significant future achievement of sustainability in urban community is the availability of cheap energy and environmental protection. The target of sustainability in building materials, production and construction techniques focuses on defined and set construction techniques in different places for achievable minimum energy building due to environmental benefits, economic achievements, thermal comfort and sustainable energy (Hyde, 2008).

The raw material used for process producing an earth building material is hereafter described in this study as "earth mix." Subsoil is the principal component of earth mix, occurring naturally between the layers of topsoil and parent rock material (Norton, 1986). Subsoil or substrata, is the layer of soil placed under the topsoil and may include substances such as sand, silt and clay that has been influenced by natural environmental events whereas topsoil consist of high organic components and microorganisms. To produce true soil However, due to the organic content, the rate of decomposition of topsoil is much greater than that of subsoil. Because of this, topsoil is too unstable to include in an earth mix. The subsoil component of an earth mix provides a 'binder fraction' and an 'aggregate fraction'. The binder fraction consists of the fine material of the soil and the cohesive properties of the binder fraction that will join the earth mix together. The aggregate fraction consists of the remainder of the soil material, excluding any organic content while the binder fraction encases the aggregate fraction and any 'stabilizing' components of the earth mix, as described below. Most subsoils naturally contain binder and aggregate fractions but the suitability of a particular subsoil as a component for an earth mix and whether any stabilization is necessary depends upon quality and proportion. Subsoil suitable for use as a building material is readily available throughout much of the world and many societies have utilized the material to fulfill a broad range of needs.

Investigations regarding ancient archaeological artifacts up to date reveal great determination about the provenance of the raw material used and also the production and construction technologies (Barone & Lo Giudice, 2005; Belfiore & Di Bella, 2010). Mud, Clay, Wood, Rock, Thatch, Brush, Sand, Gravel and Soil are the number of sustainable materials used for building construction owing to the fact that these materials have high resistance to atmospheric conditions with wide ranging properties and are geochemical pure