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Improving building technologies with a sustainable strategy

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Abstract

In recent years it has been noticed the progressive disappearance of vernacular sustainable building technologies all over the world mainly due to a strong urban rehabilitation process with modern technologies not compatible with ancient knowledge. Simultaneously new dwellings are needed all over the world and in this sense it was decided to study an ecological and cost-controlled building technology of monolithic walls that can combine the use of low carbon footprint materials, such as earth, fibres and lime using an invasive species: giant reed cane (*Arundo Donax*). This paper explains the development of this building technology through testing diverse prototypes.

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1. Introduction

After the Second World War there was a massive need for reconstruction and new housing in Europe. New construction started to grow at high speed in new planned areas outside the historic center. For this it was fundamental the development of fast setting cement-based technology to respond to these urgent housing needs (Silveira, Varum & Costa, 2007). In a period of twenty five years this technology was also introduced in rehabilitation processes in historic areas of cities and had as consequence the disappearance of vernacular building technologies in such as wattle

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and daub and lime plasters. During the last decades the majority of the rehabilitation works use cement technology (Faria & Henriques, 2004) which is not fully compatible with ancient buildings made of wood, lime and stone, creating new building pathology.

In developing countries new construction adopts modern materials such as fired bricks instead of raw earth bricks, using a large amount of wood and, therefore, increasing deforestation and soil erosion (Jerónimo & Carneiro, 2013). Because of its low cost and apparent durability modern technology has been replacing ancient technology and causing a loss in the vernacular knowledge still established in developing countries.

Trying to present alternatives to the previously mentioned status, it was decided to study an ecological and cost-controlled building technology that can combine the use of materials that have been used in old buildings in Portugal, such as lime and earth, with others with low carbon footprint, as giant reeds in the form of cane and its fibres. Giant reed cane (*Arundo Donax*) is an invasive species in southern Europe which exists in excess in Portugal. The aim is to develop a building technology capable of improving ancient vernacular knowledge but adapted to present time constraints and comfort needs. A new technology named “reedcob” was developed and has been characterized. The technology mainly consists on building monolithic walls with successive layers of a mix of earth and reed fibres, and layers of reeds. This new technology is being developed to be used mainly in new construction in Europe, where giant reed is an invasive species, but it is foreseen that, in other Continents, the reed cane can be replaced by other types of reeds or bamboo.

2. Experimental campaigns

To recover and improve ancient knowledge on earth building, as well as creating a new technology applicable for the construction of dwellings, several experiments were made related to constructive feasibility, hygrothermal behaviour and mechanical characteristics. The “reedcob” technology was developed through several prototypes: a first linear experimental wall (prototype 1), a second experimental wall including a corner (prototype 2), several small samples, wallets and a small building (prototype 3) were built to assess and analyze constructive feasibility, mechanical and physical behavior and anti-seismic performance.

In the conception, production and analysis of the prototypes two architects, three engineers and five engineering students were involved, in a partnership between FRADICAL, a lime transformation factory and the Faculty of Science and Technology (FCT) of Nova University of Lisbon.

2.1. Materials, samples and general procedures

The materials used for the walls technology were: two types of raw earth from the Caparica region, Portugal (from the University Campus and from the factory area) and, in some formulations, a grit (Fig. 1); a calcium air lime putty from FRADICAL; an artificial pozzolan based on metakaolin and brick powder from FRADICAL; in some formulations a drying additive based on oxide lime from FRADICAL; reed canes and reed fibers (*Arundo Donax*).

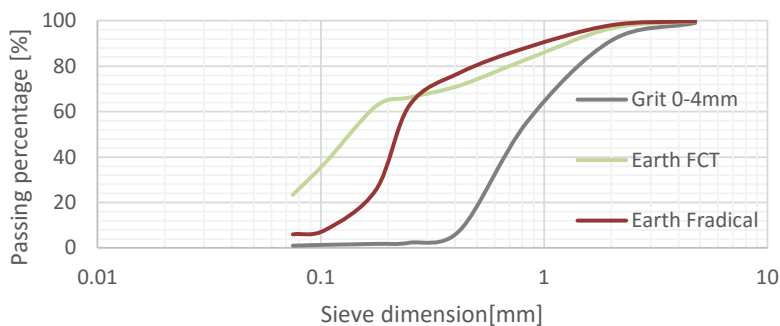


Fig. 1. Particle size distribution curve of the two types of earth and the grit used for samples and prototypes production.

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