Thermal transmittance comparison between multilayer walls made from hollow fired clay and plaster-granular cork bricks using electrical analogy

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Abstract

In this work a comparative study of thermal transmittance between different multilayer walls is examined numerically using the so called Combined Method recommended in the Moroccan standard NM EN ISO 6946/2007. For this purpose a special script was written in Mathematica based on the electrical analogy and where all the thermal transfers occurring across the brick were considered. Three configurations with and without air gap of 7 cm were compared. The first configuration, concerns walls made of cement render, cement mortar and tree sizes of hollow clay fired bricks (3, 8 and 12 cavities). In the second one, bricks were substituted with those prepared with plaster and granular cork mixes. Finally, in this second case, plaster-granular cork was used instead of cement render. In addition, the compliance with the Moroccan Thermal Regulation of Construction (MTRC) was examined. Results show that in the third configuration, double walls (with air gap) consisting of 8 or 12 cavities bricks are in accordance with all Moroccan climatic zones, leading to overall heat transfer reduction up to 51%.

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Peer-review under responsibility of the scientific committee of ICOME 2015 and ICOME 2016.

Keywords: Equivalent thermal transmittance; electrical analogy; hollow clay bricks; composite materials; energy saving; external wall

1. Introduction

Red fired clay hollow bricks, being mainly used to construct building walls, have been long known to accommodate warm homes in the winter and cool dwellings during summer; in contrast, they present several

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Peer-review under responsibility of the scientific committee of ICOME 2015 and ICOME 2016
10.1016/j.egypro.2017.11.259
disadvantages and occupy a considerable amount of building’s energy demand. Therefore many recent researches
proposed alternatives of the usual bricks, [1] studied the thermal behaviour of hollow clay bricks made up of paper
waste and optimized their thermal performance, [2] managed to reduce the total heat transfer occurring across brick
walls by 23% through placing clay protuberances inside brick cavities, also [3] improved the thermal inertia of
buildings by filling bricks with PCM. The effect of the type of PCM used, its quantity and position inside the brick
cavities were then examined. Consequently, this paper propose the use of bricks made of a new composite material
plaster-granular cork instead of fired clay bricks, this will not only guarantee a better energy efficiency inside
buildings, but will also suppress the environmental pollution resulted from the fired clay manufacturing process.

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2. Materials and method

In order to evaluate the thermal performance of different bricks inside the wall, tree types of hollow bricks
(Fig.1) frequently used in Moroccan buildings are studied; coded according to their cavities number. For easy
thermal resistance determination, the representing unit cell is consisting of two superposed bricks 8C with joining
mortar of 0.01m in thickness on the top and bottom of each brick and between the two bricks, and with external and
internal render of 0.02m; represented in Fig. 2 a. Thermal conductivities of basic materials and of the composite
material studied; picked from [4, 5], are given in table 1.
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