Contents lists available at ScienceDirect

Construction and Building Materials

journal homepage: www.elsevier.com/locate/conbuildmat

Effects of the anisotropy of extruded earth bricks on their hygrothermal properties

P. Maillard [a,*], J.E. Aubert [b]

[a] Centre Technique de Matériaux Naturels de Construction (CTMNC), Service Céramique R&D, Ester Technopole, 87069 Limoges Cedex, France
[b] Université de Toulouse, UPS, INSA, LMDC (Laboratoire Matériaux et Durabilité des Constructions), 135 avenue de Rangueil, F-31 077 Toulouse Cedex 4, France

HIGHLIGHTS

- Unfired clay bricks were made by an extrusion process.
- The hygrothermal properties differed according to the side considered.
- The extrusion process influences clay platelet orientation and hygrothermal properties.

ARTICLE INFO

Article history:
Received 2 December 2013
Received in revised form 3 March 2014
Accepted 1 April 2014

Keywords:
Earth construction
Earth brick
Thermal conductivity
Water vapour permeability
Anisotropy

ABSTRACT

The study focuses on the thermal and hydric properties of extruded earth bricks. The thermal conductivity and water vapour permeability tests highlight anisotropic behaviour of the bricks depending on the extrusion direction during the production process. The results confirm that the extrusion process has a major influence on the orientation of clay layers and has an impact on the hygrothermal properties.

1. Introduction

Earth is one of the oldest building materials still in use [1,2] and the interest in traditional earth construction (rammed earth, adobe, compressed earth blocks) has grown in Europe in recent years. This is also the case in France for several reasons, the most important being the low impact of this material on the environment and its ability to regulate the hydrothermal conditions of the indoor climate. With the recent keen interest in sustainable development, earthen constructions have become very attractive and French brick manufacturers are increasingly developing extruded earth blocks to enlarge their product range. This has an impact not only on the environment but also on the economy. Morton indicated that if bricks were not fired, more than 80% of the embodied energy of a fired clay brick could be saved [3]. One of the advantages of the extrusion process is that it enables fast production of large quantities of homogeneous bricks that are similar in shape and size.

This growing interest in traditional earth building has led to numerous publications, mainly on rammed earth buildings and compressed earth blocks [4–9]. However, few publications have concentrated on extruded bricks [10–14]. In the absence of specific standards for mechanical and hygrothermal properties, the characterization of this material is not simple. Aubert et al. have demonstrated that the mechanical characterization of extruded bricks is complex [10]. The few papers on extruded earth bricks deal only with the compressive strength of these materials and there are hardly any publications on their hygrothermal properties (with the rare exception of [14]). It also seems necessary to complete their characterization so as to meet the construction requirements and to demonstrate the particular qualities of the material because earth constructions are well known for their good hygrothermal properties.

The properties of earthen construction materials (and in particular their homogeneity and anisotropy) depend strongly on

* Corresponding author. Tel.: +33 (0)6 99 99 84 99; fax: +33 (0)5 55 35 57 68.
E-mail address: p.maillard@ctmnc.fr (P. Maillard).

http://dx.doi.org/10.1016/j.conbuildmat.2014.04.001
0950-0618/