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Mechanics Research Communications 33 (2006) 370–384
MECHANICS RESEARCH COMMUNICATIONS
www.elsevier.com/locate/mechrescom

Experimental investigations of the joint-mortar behaviour

L. Abdou *, R. Ami Saada, F. Meftah, A. Mebarki

Laboratoire de Mécanique, Université de Marne-La-Vallée, 5 Boulevard Descartes, Cité Descartes, 77 454 Marne-La-Vallée Cedex 2, France

Available online 18 March 2005

Abstract

An important failure mode of the masonry walls is the shearing process in joint mortar. In order to understand better this phenomenon, an experimental study is carried out on half brick couplet specimen. Load/Unload shear tests are performed to assess the type of the shear behaviour of the joint mortar. The cohesion and the internal friction angle are then derived from linear regression while assuming Mohr–Coulomb criterion. In particular, the influence of holes on the joint behaviour is studied by comparing results obtained with both solid and hollow bricks. In both cases, the experimental results show that there is not any stiffness degradation even in the softening regime. Actually, the shear modulus remains constant. Hence, the joint behaviour is considered to be elastoplastic, independently on the brick type. However, it seems that the presence of holes increases the stiffness but does not affect the internal friction angle of the joint mortar.

Keywords: Cohesion; Friction; Holes; Joint mortar; Masonry; Shear

1. Introduction

Unreinforced masonry is a composite material made by assembling blocks or bricks with mortar joints. The overall behaviour of this set is influenced by several factors, such as: brick and mortar properties, brick size and its aspect ratio, joint thickness, joint orientation, relative position of head and bed joints, properties of the unit/mortar bond and workmanship (joint quality) (Sutcliff et al., 2001). The failure of the masonry structures may occur in the bricks, in the mortar or in their interface. Cracking and crushing may occur in the brick and/or in the mortar. In the brick/mortar interface, two failure modes are possible: tensile failure and shear failure. The first lead to joint opening and the latter to joint sliding with friction.

* Corresponding author. Tel.: +33 160 95 77 93; fax: +33 160 95 77 99.
E-mail address: leila.abdou@univ-mlv.fr (L. Abdou).

0093-6413/$ - see front matter © 2005 Elsevier Ltd. All rights reserved.
doi:10.1016/j.mechrescom.2005.02.026

The present work deals with the experimental study of the shear behaviour of the brick-mortar combination. Many researchers have already studied this behaviour by performing tests on masonry specimens with several horizontal and vertical joints (Lourenço et al., 2004; Riddington and Ghazali, 1988), or on small specimens containing only one set of joint (Pluijm, 1993; Raffard et al., 2001; Jukes and Riddington, 2001; Hamid and Drysdale, 1982). These specimens are made of two half bricks named *couplet* (Pluijm, 1993; Raffard et al., 2001), three (*triplet*) (Jukes and Riddington, 2001) or four half bricks (Hamid and Drysdale, 1982) (see Fig. 1, (Crisafulli, 1997)).

The aim of this study is to investigate experimentally the shear behaviour of bed joint masonry by performing tests in *couplet* specimens. Two types of clay bricks (solid and hollow), made of the same basic material, are used in combination with the same type of mortar in order to study the influence of the holes. Load/Unload shear tests enable the identification of the shear behaviour type for the mortar joint.

The main purposes of this experimental study are to analyse:

- Whether any stiffness degradation occurs (elastoplastic behaviour or damaged elastoplastic behaviour for instance).
- Whether the joint mortar behaviour depends on the type of bricks (solid or hollow).
- How the classical Mohr–Coulomb criterion can be adopted ?

The conclusion derived during this study can be useful in order to develop an interface model (Abdou et al., 2004). In this case, the interface element is used to reproduce the behaviour of both, joint mortar and the interface between brick and mortar.

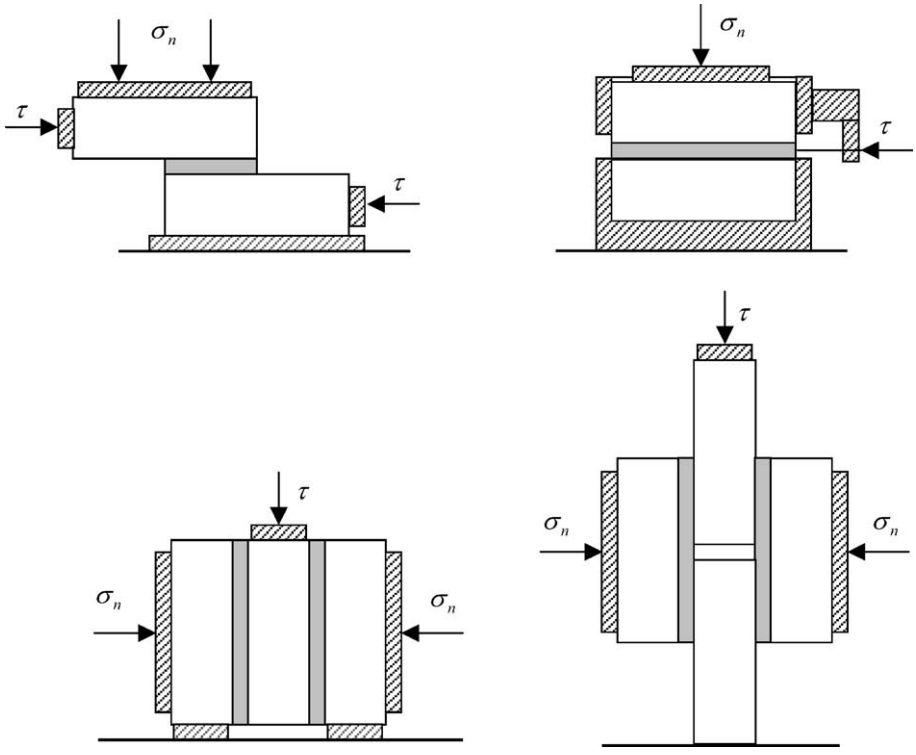

Fig. 1. Specimens used for the study of the shear behaviour of the bed joints (Crisafulli, 1997).