Construction and Building Materials 53 (2014) 203–212

Contents lists available at ScienceDirect

Construction and Building Materials

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

Experimental global analysis of the efficiency of carbon fiber anchors applied over CFRP strengthened bricks

Carmelo Caggegi [a,b,*], Vincent Pensée [b], Mario Fagone [c], Massimo Cuomo [a], Luc Chevalier [b]

[a] Department of Civil and Environmental Engineering, University of Catania, V. le A. Doria, 6, 95125 Catania, Italy
[b] Université Paris-Est, Laboratoire Modélisation et Simulation Multi Echelle, MSME UMR 8208 CNRS, 5 bd Descartes, 77454 Marne la Vallée, France
[c] Department of Civil and Environmental Engineering, University of Firenze, Via di S. Marta, 3, 50139 Firenze, Italy

HIGHLIGHTS

- We design 6 different series of reinforced brick fastened by fiber anchor.
- We measure the peak load and the energy dissipated during 36 single shear tests.
- We define the efficiency of each one of the anchor configurations tested.
- The use of anchors increase the load peak of the CFRP reinforcement.
- The anchors give a residual post peak resistance to the system tested.

ARTICLE INFO

Article history:
Received 7 August 2013
Received in revised form 20 November 2013
Accepted 21 November 2013

Keywords:
Fiber anchor
Reinforcement
FRP
Debonding
Masonry
Brick
Experimental analysis
Mechanical anchor

ABSTRACT

The study focuses on the improvement of the cohesion strength of CFRP-to-substrate bonded joint by means of mechanical anchors built with the same fibers as the composite and plugged, in the substrate, like "nails". Research on the use of this typology of anchor for masonry substrates has been limited. The aim of this study is to provide experimental data to quantify the efficiency of the carbon fiber anchors on the strength of a reinforced brick. The research demonstrates that the use of CFRP anchors increases the resistance and the dissipation capability of the reinforcement if the anchors are properly placed.

1. Introduction

The use of FRP sheets for the reinforcement of existing masonry in buildings has become widespread in the last ten years. High tensile strain and stiffness, light weight, flexibility and resistance to corrosion are the principal properties that explain the extensive use of these materials in civil engineering. However, tensile fracture is rarely responsible for the failure of these reinforcement typologies, the main reason for failure mode being premature debonding of the FRP sheet from the substrate at a stress level that is much lower than the tensile capacity of the composite [1]. The load is transferred from the composite to the substrate mainly *via* shear stress and it has been observed that it is concentrated at a short length near the loaded side of FRP adhering to the substrate: the maximum extension of this length is called "effective bond length" [2,3].

Numerous experimental analyses, by means of double or single shear tests [1], have been performed to study the adhesion between concrete substrates and FRP materials. It has been demonstrated that the debonding failure of unanchored FRP reinforcement sheets is mainly characterized by a cohesive fracture in the concrete, a few millimeters beneath the substrate-composite interface [1,2]. Since this is the main typology of failure, the characteristics of the substrate (fracture energy, tensile resistance, etc.) play an important role in the efficiency of the bond. Parallel to experimental investigations, many numerical models have been developed to schematize the mechanics of the FRP sheet-concrete adhesion problem [2,4–6]. On the contrary, there has been very

* Corresponding author at: Department of Civil and Environmental Engineering, University of Catania, V. le A. Doria, 6, 95125 Catania, Italy. Tel.: +39 3286215262.
E-mail address: caggegict@gmail.com (C. Caggegi).

0950-0618/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.conbuildmat.2013.11.086