Model Proposal for Flexural FRP Strengthening of Masonry Walls

Sonia MARTÍNEZ DE MINGO
Research Architect
Madrid, España
soniamartinezdemingo@hotmail.com

Sonia Martínez, born 1971, received her architect degree from Polytechnic University, Madrid. She has completed her Ph.D. Thesis on flexural strengthening of masonry walls with externally bonded FRP laminates.

José Pedro GUTIÉRREZ JIMÉNEZ
Research Engineer
IETcc-CSIC
Madrid, España
jpgutierrez@ietcc.csic.es

J. Pedro Gutiérrez, born 1950, received his civil engineering degree from Polytechnic University, Madrid. In the last 30 years, he has worked and researched in computational methods for structural analysis and pathology and assessment of structures.

M. Dolores GARCÍA ALONSO
Research Architect
ETSAM-UPM
Madrid, España
mariadolores.garcia@upm.es

M. Dolores García, born 1962, received her architect degree from Polytechnic University, Madrid. Her Ph.D Thesis dealt with the consequences of steel corrosion on RC structures. In last years her research has been related to FRP materials as structural strengthening.

Summary

Nowadays there is an increasing need of reusing/recycling existing means. This also occurs in construction field where numerous ageing buildings and infrastructures need to be upgraded. Externally bonded FRP (*fiber reinforced polymer*) laminates has been proven a useful technique for structural strengthening not only for reinforced concrete structures but for others like masonry ones.

An ultimate limit state method to design and check unreinforced masonry sections with externally bonded FRP strengthening subject to bending and compression has been developed.Different design formulations are proposed with the aim of covering all flexural failure modes. The work focuses on determinate a “bond reduction factor” to assess the value of FRP design strain. This factor must prevent intermediate FRP debonding failure. The proposed factor is obtained by means of an extensive bending test database. The method has also been checked with the help of this database.

Keywords: Composites, FRP, Masonry structures, Strengthening.

1. Introduction

Masonry is characterized for being a good material to support compressive stresses but really bad to withstand tensile ones. For this reason, unreinforced masonry walls are vulnerable to earthquake or high wind loading. On the other hand, glue FRP plates can improve the flexural capacity of masonry elements subject to bending.

This kind of strengthening may be interesting mainly in the event of damage due to exceptional events (such as earthquakes), damage occurring with time in the life of a building (such as differential soil settlement) or in the event of an increase in live loads (1). Several samples of this technique applied to masonry elements have been carried out in Italy (2).

Experimental tests have shown FRP materials can improve significantly the bending capacity of masonry walls, however, most of them have been carried out in pure bending (3), (4), (5), (6), (7), (8). Only some tests were tested combining bending and compression (9), (10), (11), (12).

In regards of theoretical studies, there are different proposals based on reinforced concrete analytical methods (3), (4), (5), (7), (8), (13). However, they present important differences:

- The constitutive law of masonry. Some authors prefer an elastic approach for masonry because of the most common failure mode is due to FRP laminate debonding from masonry substrate. However, other researchers consider masonry has a nonlinear behavior in compression and use a simplified rectangular stress block. This can be proper for failures due to crushing masonry.

- The way of assessing the FRP design strain. It must be taken into account that the FRP ultimate strain value provided by manufacturer can´t be reached when it is bonded to a structural element.

- The desirable failure mode that must be looked for.

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