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Gehan Hamdy, Osama Kamal, Osama Al-Hariri, Tarik El-Salakawy

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Gehan Hamdy*, Osama Kamal, Osama Al-Hariri and Tarik El-Salakawy

Civil Engineering Department, Faculty of Engineering at Shoubra, Benha University
108 Shoubra Street, Shoubra 11241, Cairo, Egypt
gehan.hamdy@feng.bu.edu.eg , osama.kamal@feng.bu.edu.eg,
osama.elhariri@feng.bu.edu.eg , tarek.abdelgalil@feng.bu.edu.eg

ABSTRACT: This paper presents numerical modeling and nonlinear analysis of unreinforced masonry walls and vaults externally strengthened by different techniques. The aim of the research is to provide a simple and reliable calculation method to enable the design and structural evaluation of strengthening measures for masonry plane and arched structures. Numerical modeling by finite elements and nonlinear analysis are carried out using commercial software ANSYS12.0. In order to validate the adopted approach, an experimental program was conducted where unreinforced brick masonry walls and vaults were strengthened by several techniques and loaded until failure. Comparison of experimental and numerical results showed acceptable agreement. Furthermore, a parametric study is conducted to investigate and compare several strengthening configurations for unreinforced masonry vault in order to select the optimum solution. The numerical results are discussed and the deduced conclusions illustrate the applicability of the proposed approach as a practical and valid tool for design of strengthening interventions for contemporary or historic masonry elements and assemblages.

Keywords: masonry, strengthening, numerical modeling, nonlinear analysis, vault.

* Corresponding author

1. Introduction

Unreinforced masonry walls, arches and vaults constitute the load-bearing elements of many contemporary and historic structures worldwide. These structures are often subjected to deterioration and damage and may require strengthening. Any intervention strategy should be based on understanding of the behavior of the existing structure as well as its behavior after the proposed retrofit measures are made [1]. Linear analysis usually performed to simplify the analysis and design of masonry structures might underestimate the structural capacity of such constructions and hence the