NON-LINEAR ANALYSIS OF MASONRY WALLS USING DIGITAL PHOTOGRAPHY

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Abstract. A methodology to analyse masonry structures using digital photography is presented. The idea is to employ with a digital photography of a masonry wall and then use techniques of images processing to obtain a finite element mesh. Then using software of non-linear analysis of structures, within the GiD environment, a complete study of the mechanical behaviour of the material can be performed.

1 INTRODUCTION

The objective of this study is to analyze any type of masonry wall, as can be: masonry bricks wall, masonry stones wall with regular and irregular forms. The only condition is that the different geometries can be distinguished with a naked eye. Starting with a digital photography, the geometry of the wall can be obtained. With this geometry an structural non-linear analysis of the masonry behaviour under different loads using of finite element method software can be performed. With a non-linear structural analysis, the behaviour of the wall under several boundary conditions and the evolution of the damage parameter to traction and compression can be studied. The evolution of these damage parameters represents the cracking of the wall. The information obtained from this analysis is very valuable, as can be used to predict the behaviour of the walls and to find the cause of their break.

2 DIGITAL PHOTOGRAPHY

In the analysis of images by computer is available a wide range of items ranging from light sources to illuminate the objects necessary to classify them responsible for the algorithms. By applying different techniques of image preprocessing and morphological changes can lead to extract the features that lead to the stages of interpretation and appreciation geometries.

One of the most useful information of the image are the edges that delimit the objects, as they define the limits between them and the background and between the objects together, edge detectors are aimed at the location of the points on there is a variation of intensity.

For the extraction of geometries from photographs always follow the same process:

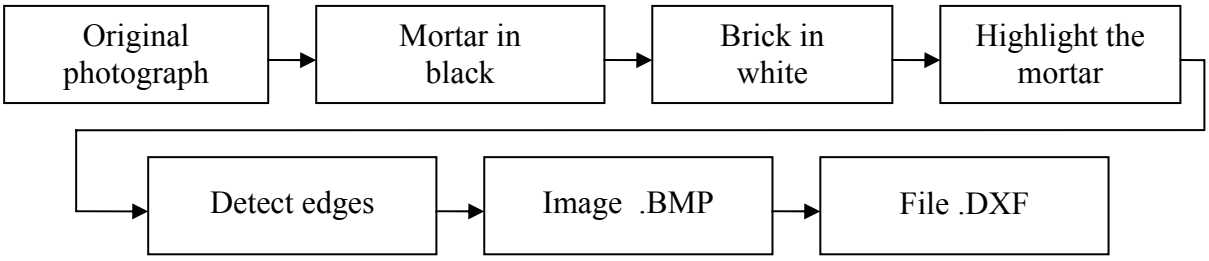


Fig 1. Flow chart.

Based on the entire picture select mortar and turn to black, then invest the selection in this case will be selected bricks or stones from the wall and paint these in white. The next step is to highlight the mortar, use the filter dilate (expand and enhances the dark areas). Currently photography has become in black and white and with the edges of the bricks well defined. Finally save the image format. Bmp, and pass directly the format .Bmp to .Dxf. In this moment we can introduce geometry in the analysis program.

3 CONSTITUTIVE EQUATION

The non-linear model of damage to traction and compression use the following equation:

$$\sigma = \left(1 - d^{-}\right)\overline{\sigma}^{-} + \left(1 - d^{+}\right)\overline{\sigma}^{+} \tag{1}$$

This is a variable which range between “zero” while material is elastic and “one” when material reaches. The damage parameter indicates the status of damage at each point and represents the cracking of the wall.
In his view can be seen where the wall breaks, and where the crack moves.

4 APLICATIONS

a-) Process for obtain the geometries

Starting from the original photograph of a wall, we get the different geometries that define the bricks or stones that make up it.

Irregular wall:

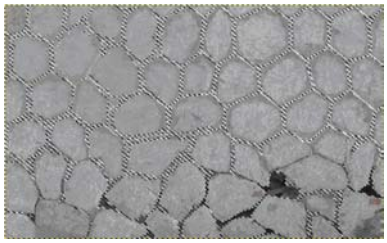
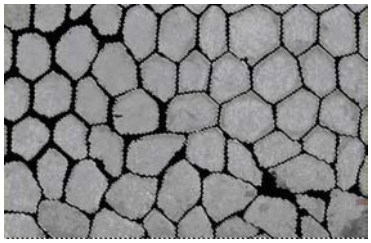
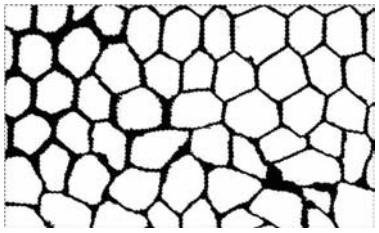
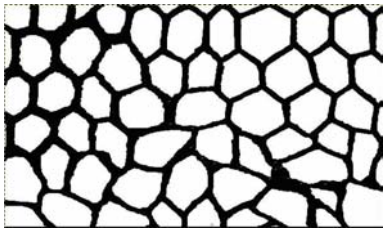
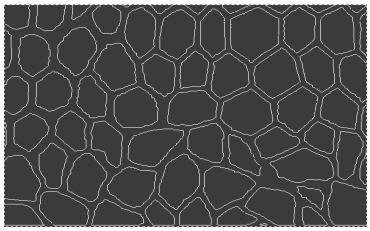
		
Original photography (.jpg)	Selection of the mortar	Mortar in black
		
Stones in white	Filter dilate	Filter Laplace (.bmp)

Fig 2. Obtaining the geometry.

b-) Non-linear analysis

For the analyses always follow the same steps: Introduce the data, calculation and finally display the results.

- Data input:

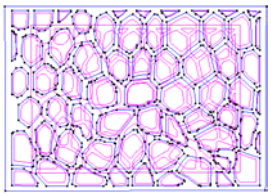
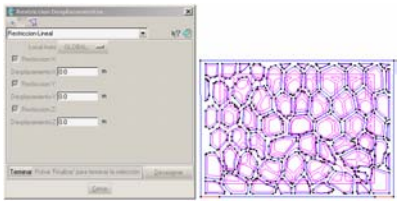
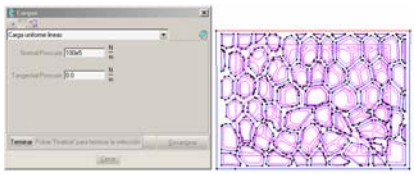
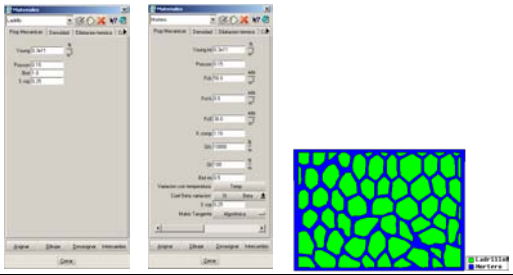
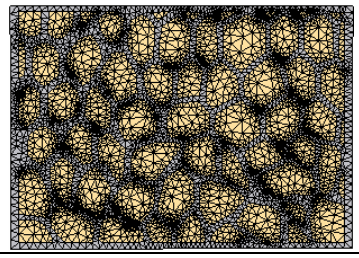
		
Geometry at GID.	Restrictions.	Load.
		
Properties.	Mesh.	

Fig 3. Introduction of data.

- Display the results:

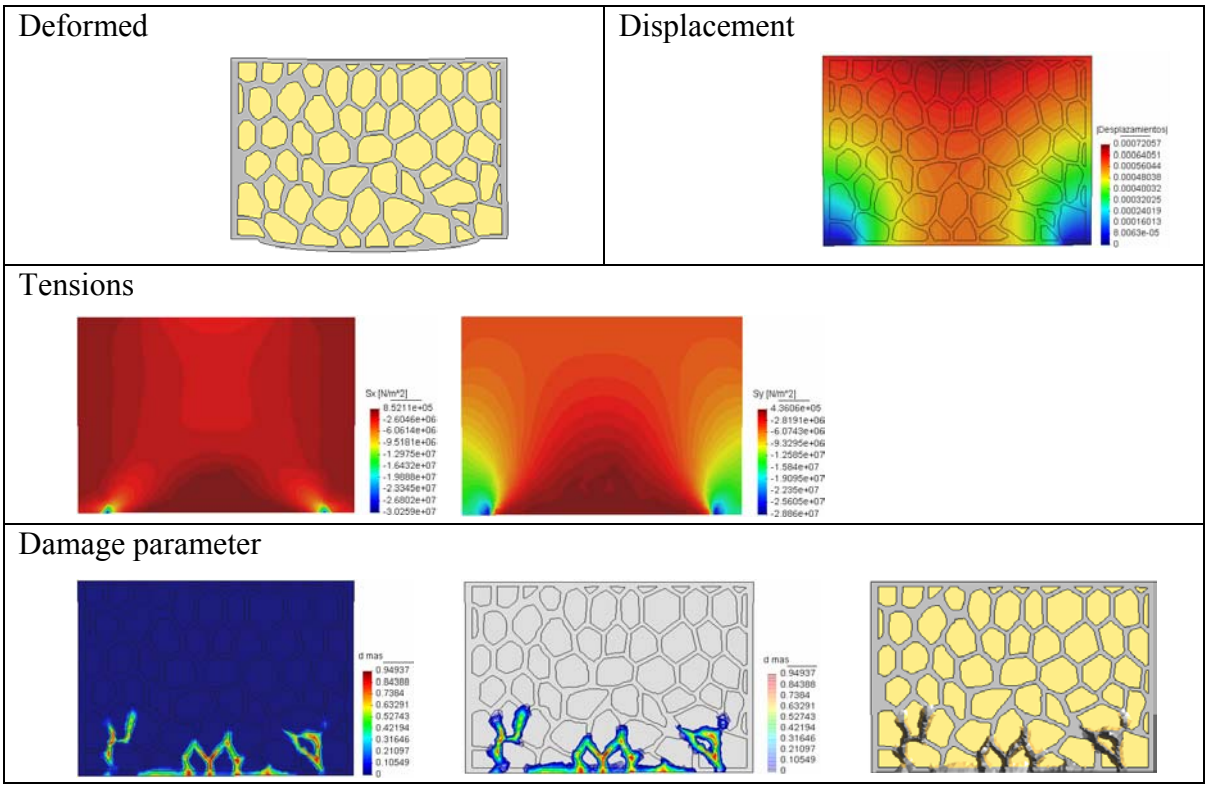


Fig 4. Display the results.

5 REFERENCES

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Rui Faria[1]; Javier Oliver[2]; and Miguel Cervera[3]. Modeling Material Failure in Concrete Structures under Cyclic Actions. JOURNAL OF STRUCTURAL ENGINEERING © ASCE / DECEMBER 2004 / 1997