



Uncertainty sources in the structural assessment of masonry arch bridges: a case study of a single-span stone arch bridge

B. Conde, B. Riveiro, M. Cabaleiro, J.C. Caamaño

University of Vigo, Vigo, Spain

G. E. Stavroulakis

Technical University of Crete, Crete, Greece

Contacting author: bconde@uvigo.es

Abstract

In this work, the evaluation of some of the most common uncertain parameters present in the structural assessment procedure of masonry arch bridges is addressed. The Xuño Bridge, a single-span stone arch bridge located in Galicia (Spain) is considered as a case study. This structure presents the particularity that after hundreds of years, all its constructive elements have disappeared except the arch barrel. Thus, the typical scattering in the thickness of this element can be measured and quantified. For that purpose, an in-situ terrestrial laser scanner survey was conducted, acquiring its exact geometry. An uncertainty analysis, considering geometrical and material parameters, was then conducted with the aim of estimating the impact of the uncertainty sources in the prediction of the collapse load of the arch. Two different numerical modeling strategies were employed, the limit analysis approach and the finite element method. A sensitivity analysis was finally performed to identify the critical parameters on the response of the structure.

Keywords: masonry arch bridges, unilateral contact-friction, limit analysis, non-linear FE analysis, uncertainty analysis, sensitivity analysis.

1. Introduction

Masonry arch bridges are present in many countries around the world where they constitute a significant percentage of the built infrastructure stock (1). Moreover, they are also pieces of incalculable historical value, which is important to preserve. However, assessing the safety condition of these types of ancient constructions is often a difficult task, due to the confluence of two main factors: a complex mechanical behavior and the presence of many uncertainty sources (2). This work aims to evaluate the uncertainty in the estimation of the collapse load of existing masonry arch bridges given the uncertainty in

some of the most common geometrical-mechanical parameters. This type of analysis is commonly known as uncertainty analysis. A further step will also be done, which consists in determining from the set of analyzed structural variables (inputs) which of them are contributing the most to the uncertainty of the collapse load (output response). This type of analysis is usually known as sensitivity analysis. Both of them are conducted on this work by focusing the study on the mechanical response of the main structural element of a masonry bridge: the arch barrel. For this purpose, the Xuño Bridge has been selected as a case study since it presents the particularity that after hundreds of years most of the structure