



# The seismic performance-based assessment of a masonry building enclosed in aggregate in Faro (Portugal) by means of a new *target structural unit approach*

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## ABSTRACT

The seismic vulnerability assessment of unreinforced masonry buildings within historical centres is a very challenging research subject given the inaccuracy of investigating these buildings as independent structures. Indeed, these buildings are often part of complex structural systems, which may differ in geometry, building materials, construction techniques and maintenance condition, as they result from an urban continued growth phenomenon, in adjacency and continuity with the existing built environment. For this reason, when assessing the seismic vulnerability of buildings enclosed in aggregate, the reciprocal interactions with adjacent structures should be considered. However, even though several studies have been performed in recent years to address this issue, it is not yet clear how to represent these interactions in numerical models, without the need for modelling the entire aggregate.

Hence, this study aims at understanding how the “aggregate effect” should be modelled for a more accurate seismic assessment of unreinforced masonry buildings located within historical centres. To this end, an innovative procedure, from now on referred to as “target structural unit approach”, was developed, aiming at identifying the optimal portion of the aggregate that best represents the “aggregate effect” for the investigated structural unit, i.e., the Minimum Unit of Analysis (MUA). This procedure is based on a multi-level analysis of the seismic response of the target structural unit, investigating different modelling configurations in addition to the complete aggregate or the isolated building. The evaluation is preliminarily performed at global- and wall-level; then, the structural unit-level is introduced as additional verification level, with the aim to understand the variability of the seismic response of the case study building in function of different boundary conditions.

The procedure herein proposed was employed to a case study located in the “Bairro Ribeirinho” neighbourhood in Faro (Portugal), by performing nonlinear static analyses using a software code based on the macro-elements approach.

Although just some first results are shown and further investigations are needed, the proposed approach can be used for the validation of seismic assessment strategies specific for masonry buildings enclosed in aggregate.

## 1. Introduction

The seismic safety assessment of masonry buildings enclosed in aggregate is a matter of great importance since they are a comprehensive structural typology in historical centres across the world. As they usually comprise different structural typologies and a wide range of construction materials, their analysis is naturally affected by several sources of uncertainties, for example, related to the knowledge level of

construction techniques, mechanical properties of materials and effective structural organisation. For this reason, Carocci [1] highlighted the importance of performing a preliminary “critical reading” of the construction techniques and the diachronic construction process of the building aggregate as a fundamental step that should precede the assessment phase.

A masonry aggregate is usually divided into several “structural units”, which are characterised either by structural in-height continuity

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