

# **A QGIS plugin for the seismic vulnerability and damage assessment of urban centers. Application to the historic center of Popoli in Abruzzi (Italy).**

**Gonzalez A.<sup>†</sup>, Basaglia A.<sup>†</sup>, Spacone E.<sup>†</sup> and Brando G.<sup>\*†</sup>**

<sup>\*</sup> Corresponding Author: Department of Engineering and Geology  
University “G. D’Annunzio” Chieti-Pescara  
Viale Pindaro 42, 65127 Pescara, Italy  
Email: giuseppe.brand@unich.it

<sup>†</sup>Department of Engineering and Geology  
University “G. D’Annunzio” Chieti-Pescara  
Viale Pindaro 42, 65127 Pescara, Italy

## **ABSTRACT**

Seismic risk maps are valuable instruments for stakeholders or insurance companies. Seismic risk is the combination of vulnerability, hazard and exposure. The vulnerability depends on the quality of structures and infrastructure. The hazard depends on the potential intensity of a rupture in the area under assessment. The exposure concerns the possible socioeconomic losses due to an earthquake damage.

Seismic vulnerability assessment of buildings is of paramount importance as it allows the identification of those areas in a city which demand higher attention. Methods for evaluating seismic vulnerability include predictive models or the adoption of fragility curves databases by dividing buildings in typologies (a more expedite evaluation). Both methods require a sufficiently accurate survey of buildings’ geometrical and structural features. However, even for small sized cities, the task of deriving vulnerability maps may be very time consuming. Therefore, the development of automatic tools for mapping vulnerabilities of urban areas can significantly reduce this effort.

QGIS ([www.qgis.org](http://www.qgis.org)) is a free open source geographic information system (GIS) software that includes a variety of peculiar packages making it a powerful tool. QGIS can be empowered or adapted with new components or plugins. In this paper, we present a plugin that assist in the generation of vulnerability maps of urban areas. The developed software can provide a detailed application of a predictive model for a seismic vulnerability assessment of selected buildings when the necessary data are available. In addition, it is possible to apply both the available predictive method (for example those ones based on the definition of vulnerability indices) or a set of fragility curves for each structure under assessment. In this way, the User can automatically generate damage scenarios for different earthquake events.

The QGIS tool is applied to the historic city center of Popoli, in the Abruzzi region, Central Italy, which is a high seismicity area affected by two major seismic sequences in 2009 and in 2016-2017. Damage scenarios are presented and discussed, deriving useful informations that could be applied in risk mitigation strategies.