

Fuzzy logic based rapid visual screening methodology for structural damage state determination of URM buildings

Nurullah Bektaş¹, Orsolya Kegyes-Brassai²

¹ Széchenyi István University, Department of Structural and Geotechnical Engineering,
9026, Győr, Hungary (nurullahbektas@hotmail.com)

² Széchenyi István University, Department of Structural and Geotechnical Engineering,
9026, Győr, Hungary (kegyesbo@sze.hu)

Abstract

Most of the Unreinforced Masonry (URM) buildings are quite old in Europe based on “*Building stock inventory to assess seismic vulnerability across Europe*” (Valentina et al., 2018) report. Following the earthquakes (Albania, Italy, etc.) that occurred in Europe, it was revealed that masonry buildings are extremely vulnerable. While probabilistic and deterministic approaches are important for examining a small number of buildings, they do not offer the opportunity to examine a large building stock in a short period of time. Rapid Visual Screening (RVS) methods are used to identify building pre- and post-earthquake vulnerability. Several RVS techniques have been presented in literature over last 30 years. Recent earthquakes have highlighted critical necessity of a rapid vulnerability assessment method for pre-earthquake warning, mitigation, preparedness, and post-earthquake damage state assessment of existing buildings. These findings demonstrate the importance of using an accurate RVS technique to inspect buildings. Because of the screener's subjectivity, these RVS methods contain uncertainty and vagueness. Fuzzy Inference System (FIS) overcomes nonrandom uncertainty and vagueness by considering building characteristics in terms of their degree of truth. This paper introduces a FIS-based RVS case implementation and compares FIS-based RVS to traditional RVS methods for identifying building damage state taking into account rapid visual assessment reports about damage caused by the 2019 Albania earthquake. To determine the damage states of URM buildings, 25 buildings damaged in the 2019 Albania earthquake were analyzed and processed to use in the applied fuzzy logic mathematical model. Initial findings demonstrate that site-specific FIS-based RVS method outperforms conventional RVS methods in terms of damage state prediction accuracy. Even on availability of new data the reliability of results could be further increased considering self-development capability of this method.

Keywords: Fuzzy Logic, Rapid Visual Screening, Unreinforced Masonry Buildings, Seismic Vulnerability, Damage

References

Valentina, P., Georgios, T., & Luisa, R. D. M. D. N. E. S. D. S. M. M. (2018). *Building stock inventory to assess seismic vulnerability across Europe* (978-92-79-86707-1; No. JRC112031). Publications Office of the European Union. <https://publications.jrc.ec.europa.eu/repository/handle/JRC112031>