

# Seismic Assessment of Dutch URM Buildings according to NPR9998:2018 Code with an Equivalent-Frame Approach

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## ABSTRACT

In the last two decades, the region of Groningen, located in the North-East of the Netherlands, has been subjected to an increasing number of earthquakes induced by gas extractions. The existing building stock is mainly composed by unreinforced masonry (URM) buildings not conceived to resist seismic loads.

The need of reducing the vulnerability of these buildings by means of retrofit interventions, led to the development and adoption of a new building code (NPR9998:2018, [1]). As regards the seismic assessment of URM buildings using nonlinear static analysis, the code includes significant differences with respect to Eurocode 8 [2][3], which is adopted in other European countries. The more significant differences lay in the failure mechanisms and constitutive laws of piers and spandrels, in the identification of limit states and in the calculation of seismic demand. In the last years, the assessment and retrofit in the region has been carried out using software based on an equivalent-frame strategy: among these, the 3Muri software [4] has been widely adopted. The solver of this program is the research software TREMURI [5].

In this work, a new version of the solver adopted by the software 3Muri, complying with the requirements of the new Dutch code, was developed; the tool was then validated by means of simple examples. To illustrate the peculiarities of the new code, the seismic assessment of buildings representative of the most widely diffused URM building typologies in the area was performed according to the new code NPR9998:2018 [1]. Finally, comparisons with results obtained by means of different code standards (e.g. Eurocode 8 [2][3]) and more refined nonlinear dynamic analyses were carried out.

## REFERENCES

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