

# Seismic Behaviour of La Merced temple in Morelia, Mexico

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## ABSTRACT

This paper studies the seismic behaviour of the temple of La Merced, dating from the beginning of s. XVII, and is located in the historic center of the city of Morelia, considering the September 19, 2017 earthquake accelerations obtained in seismic stations located near the epicenter.

The temple nave was modelled using two-dimensional macroelements in the transverse and longitudinal direction, which were analysed using Rigid Elements (Casolo and Peña, 2007, Martinez *et al.*, 2010), which are a simplification for the linear and non-linear analysis of ancient masonry. A set of 10 real seismic records were used without any scaling factor and then applying a scaling factor reaching the maximum peak ground accelerations expected on the site for probabilistic return periods of 475 years and 975 years.

Time-History nonlinear analyses were performed in a first stage of analysis only considering the horizontal shaking component and in a second stage the effect of horizontal and vertical component was taken into account acting simultaneously. In all the analyses the compression and shear damages were neglectable and a level 4 (where 0 is without damage and 4 is maximum damage) traction damages were presented on the intrados vault keystone, and on some voussoir in the area of the impost which where it connects with a large size buttress, element that shows type 4 damages either. It was also observed that the buttress introduces a displacement on the nave, which not only affects the vault springer on the right side where it connects but also the left side springer which is not foreseen of any buttress. For the analyses with the non-scaled seismic signals where the maximum accelerations are higher than those of the return periods of 475 and 975, the damages were more extensive in the aforementioned areas, and considering the vertical seismic accelerations acting simultaneously with the horizontal ones, the damages increased significantly reaching in some cases the vault collapse for the 975 years recurrence.

In conclusion the damages increases significantly when the vertical component of the earthquake is acting simultaneously with the horizontal component, prevailing a high vulnerability in historical structures before near-field earthquakes in which the vertical acceleration are significant.

## REFERENCES

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