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## Modelling of seismicity-induced cracking of stone columns using discrete-element-method (DEM), a case study of Eufrasius cathedral, Porec, Croatia

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The Eufrasius Cathedral of Poreč in Istria Peninsula, Croatia, was built in the 6th century, The nave collapsed in parts due to the AD 1440 earthquake. Nave and aisles are supported by 18 monolithic columns of Proconnesian marble. Seventeen of the columns bear various fractures, forming two groups: (1) axis-parallel fractures and (2) oblique fractures. Azimuths of dip directions of oblique fractures indicate N-S shaking.

In this study, the fracture development and cracking of a stone column was modelled using computer code. To model the current fracture pattern and to link it to seismic activity a Lagrangian analysis of continua in three dimensions (FLAC3D) is employed to reveal the non-linear behaviour of the stone column. A 3-Dimensional model based on discrete-element-method (DEM) has been created to study the failure process of the ancient stone column under static and dynamic loads. A combination of vertical and horizontal loads with a dynamic load due to the earthquake has been imposed horizontally. The influence of different parameters such as mechanical properties of rock, the magnitude of the earthquake were also assessed to observe their influence on the failure mechanism of rock. The DEM model was able to describe the observed crack pattern and it has proved the applicability of FLAC3D to describe failure mechanism of stone columns.