Fragility analysis of the nave macro-element of the cathedral of Santiago, Chile

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Abstract

This paper presents the fragility analysis of a typical nave macro-element of the Metropolitan Cathedral of Santiago, Chile. The analysis is carried out by using the rigid body spring model approach, in which rigid elements are connected to each other by means of axial and shear springs. The 2D model generated is initially verified by comparing modes with a 3D finite element model previously calibrated in DIANA software. The methodology used in this study is based on a set of eleven real seismic records corresponding to four major earthquakes that have affected Santiago city. Nonlinear incremental dynamic analyses together with a damage index based on stiffness degradation, which considers the relation between shear at the base and deformation of the macro-element, are used to generate the fragility curves. As a result of this study, the probability of exceedance for different damage states has been obtained based on a possible peak ground acceleration of the site. In particular, the results of the study demonstrate that the proposed damage index satisfactorily describes the damage suffered by some of the nave transverse sections of the Cathedral after the 2010 Maule earthquake (PGA 2.11 m/s2—Santiago Centro station).

Keywords

Heritage buildings, Fragility análisis, Nonlinear análisis, Masonry building, Rigid body spring model (RBSM).