



Rockfall vulnerability assessment for masonry buildings

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The methodologies for the quantitative risk assessment vary in function of the application scale and the available data. For fragmental rockfalls, risk calculation requires data for the expected damage of the exposed elements due to potential rock block impacts with a range of trajectories, magnitudes and intensities. Although the procedures for the quantification of the rock block characteristics in terms of magnitude-frequency relationships are well established, there are few methodologies for the calculation of the vulnerability, and these are usually empirical or judgmental. The response of buildings to rock block impacts using analytical methods has been mainly realised so far for reinforced concrete buildings, and some fragility curves have been calculated with the results, indicating the potential damage for a range of rock block characteristics.

Masonry buildings, as a common structural typology in mountainous areas, are in many cases impacted by rock blocks during rockfalls. Their response presents some peculiarities in comparison with reinforced-concrete structures given the non-homogeneity and variability of the compound materials (blocks and mortar), their orthotropy, low strength in tension, the statically indeterminate load-bearing system and the non-monolithic connections. To this purpose, analytical procedures which are specifically adapted to masonry structures should be used for the evaluation of the expected damage due to rock impacts. In this contribution we discuss the application of the analytical approach for the assessment of the expected damage in rockfall prone areas and the simulation assumptions that can be made concerning the materials, geometry, loading and the relevant simplifications. The amount of uncertainties introduced during their analytical simulation is high due to the dispersion of the data for material mechanical properties and the construction techniques and quality and thus a probabilistic assessment is suggested. The random nature of the rockfall as far as it concerns the magnitude and the intensity of the rock blocks can also be introduced using parametric analyses.