Landslide hazard affecting historical buildings: Santa Scolastica monastery in Subiaco.

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ABSTRACT

Every year landslides occur as a consequence of ground conditions, geomorphological, physical or man-made processes, often triggered by heavy rainfalls or earthquakes. They affect buildings and infrastructures, causing economic and life losses. Many countries own valuable architectural heritage that is threatened by landslide hazard. On the Italian territory, more than 14,000 heritage sites interact with potentially unstable slopes [1]. In fact, during the last few years several cases of landslide induced damage or failure have been reported, including those affecting some of the historical structures of the villages of Volterra, Civita di Bagnoreggio and Craco, only to cite some.

This work investigates the effects of a landslide, occurred on the 26th of November 2018, on the Monastry of Santa Scolastica in Subiaco (Rome), one of the most ancient and well-preserved examples of medieval architecture in Central Italy.

The geometry of the slope was reconstructed based on aerial photographic survey and point-cloud processing, obtaining meshed surfaces and extracting relevant sections. The mechanical parameters and the specific hydraulic conditions triggering the failure mechanism were first recognised by traditional limit equilibrium back-analyses and then implemented in the 3D non-linear finite element (FE) model, which included both the slope and the interacting portion of the ancient structure. Elastic-perfectly plastic constitutive assumptions were adopted for the soil, while the structure was modelled by a three-dimensional anisotropic elastic-perfectly plastic constitutive model, specifically conceived for masonry, accounting for block dimensions and staggering joints effects [2].

Finite element approach proves to be very effective in the analysis of such a coupled geotechnical and structural interaction problem, leading to a realistic representation of the interplay between the soil displacements induced by the unstable slope and their deformative effects within the structure [3].

In detail, the numerical results have been interpreted to highlight the structural response in terms of crack pattern and stress distribution as induced by the interaction with the deforming slope, leading to a quantitative evaluation of the landslide-induced damage. Several scenarios were simulated: first, the pre-landslide existing crack pattern was reproduced, then the event was modelled as it occurred, evaluating its consequences on the structure. Finally, a worst-case scenario was accounted for considering a retrogressive evolution of the landslide, whose crown was assumed adjacent to the building foundations.

REFERENCES

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