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Combined use of Ground Penetrating Radar and crack meter sensors at the historical Consoli Palace of Gubbio

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Consoli Palace is one of the most iconic monumental buildings of Central Italy and it is located in the heart of the medieval historical center of the city of Gubbio, Italy, in one of the most seismically active zones of Italy. This monument shows evidence of moderate structural damages in the form of existing cracks. Some of those cracks are due to physiological process of the masonry when subjected to the self-weight, while other cracks are likely to be associated to past and recent earthquakes.
The presence of cracks together with ongoing material degradation phenomena motivated the choice of Consoli Palace as test site of the HERACLES (Heritage Resilience Against CLimate Events on Site) European project.
This contribution deals with joint use of non-invasive monitoring technologies and civil engineering analysis methods aimed at providing multi-sensing information about the structural health of historical and cultural assets. Specifically, Linear Variable Displacement Transducers (LVDT) and ground penetrating radar (GPR) are herein considered for monitoring a significant crack affecting one of the walls of the cross-hall leading to the Loggia. Such a crack appears only on one side of the wall, which is about 0.75 m thick, and its extension towards the wall interior is unknown.
In the considered applicative case, LVDT was adopted to control amplitude variations of the crack occurring in one year and it was installed across the crack together with a thermocouple in order to monitor the temperature variations and recognize thermal material displacements with respect to variations related to structural pathologies [1]. Conversely, two GPR surveys were carried out at a time distance slightly less than one year (July 2017 and May 2018) in order to investigate the wall interior and to detect the occurrence of inner issues related to the visible appearance of the crack on the wall surface. The goals of GPR surveys were pursued by exploiting a microwave tomography based data processing strategy [2].
Such a study is part of a wider analysis carried out in the frame of the HERACLES project, whose main goals are design, validation and promotion of responsive systems/solutions for the effective resilience of CH against climate change effects.

References

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