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Assessment of the instability phenomena affecting the historical village of Craco (Southern Italy)

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The village of Craco (Basilicata Region, Italy) is located on the top of a conglomerate hill overlying a gentle slope constituted by highly tectonised alloctonous Cretaceous-Miocene clayey formations (Argille Varicolori, Albidona and Saraceno) thrusted over the Pliocene clay and sand formation. Different landslide typologies and mechanisms can be recognized in the area: rock-falls and rock lateral spreadings in the upper part of the hill, rotational and translational slides and earth flows. Landslides are mainly promoted by the geological and structural setting of the area as well as by very low mechanical characteristics of sediments outcropping in the area.

In the last three decades, the southern slope has exhibited the most hazardous conditions with large and deep failure phenomena occurred in 1959, 1965 and 1971, that caused the disruption of large portions of the urban settlement and a progressive abandon by the population. Integrated geological and geomorphological surveys indicated that the southern slope has been affected by a progressive retrogression of the landslide crown areas in the upper portions of the hill up to the contact between the clayey formations and the conglomerate. The most important accumulation zones of these complex movements constitute the alimentation zones of earth flows developing downhill up to the slope toe.

The research has been aimed at assessing the stability conditions of the upper portions of the southern slope of Craco through an extended geotechnical campaign and a numerical study of the past and present instability and deformation mechanisms. The

geotechnical model of the slope in the investigated area was defined through the analysis of the logs obtained from 10 boreholes and the results of numerous mechanical test performed on undisturbed samples taken at different depths.

Several boreholes were equipped with instruments for the measurement of pore pressure evolution and slope movements. The monitoring system included also boreholes extensometers located in active slope areas, a meteorological station and a central unit for remote acquisition and transmission of monitoring data. Monitoring data, which are currently in elaboration, are expected to integrate and enhance the understanding of the instability mechanisms already detected.

The numerical study was carried out using the commercial Finite Element Plaxis in plane dimensional strain conditions, referring to a typical section extending in the upper part of the southern slope in the area interested by the main landslide affecting the historical centre of Craco. The geotechnical model developed during the first stage of the research activity was calibrated through a back analysis procedure of the 1959 failure event. By adopting a reasonable assumption concerning the hydraulic conditions in the slope, unknown at the moment of the event, this procedure allowed to determine a set of strength parameters representative of the in situ conditions along the failure surfaces. A second set of numerical analyses has been applied to the present geometry of the slope. The numerical results stressed the influence of pore pressure distributions on slope movements thus indicating the need of deep and surface drainage systems to control the deformation processes in the slope and to reduce the risk of other failure events.

The reconstruction of the landslide evolution in time through a coupled geomorphological and geotechnical approach will be useful to recommend correct mitigation strategies that may help the local administration to prevent a further environmental and social degradation of the territory and address measures and guidelines for the restoration of cultural heritage.