

Excavation works inside the Trubi stiff jointed formation

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Extended Summary

The DG22 maxi lot is part of the modernization works involving the SS106 “Jonica National Road”. DG 22 covers the road length from Marina di Gioiosa Jonica and Ardore close to the city of Siderno. The works include the construction of five double-tube tunnels for a total length of approximately 5 km.

The excavations mainly involved the Pliocene stiff, jointed silty clay deposits belonging to the "Trubi" formation, filling the basin perched between the crystalline basement main faults of the Calabrian Arc.

The Trubi formation is affected by a complex system of joints and cracks. The "Siderno Basin" is bounded to the north by the Nicotera-Marina di Gioiosa fault system, mainly consisting of fault planes dipping SW with an inclination of 70-80° and to the south, by another, less developed, system of normal faults. Coherently with the geological history of Siderno basin, the soil deposit is overconsolidated; at laboratory sample scale, its behaviour is related to index properties, water content and stress state, while, at engineering works scale, its behaviour is mainly controlled by geological structures (faults, joints and bedding planes).

When excavating in structurally complex formations, special caution should be adopted since mid-scale joints and tectonic structures can promote the activation of unexpected discontinuous type failure mechanisms.

The kinematics of these phenomena is strongly conditioned by:

- structural features relevant to the scale of the works;
- geometry and orientation of the excavation;
- stress state and degree of constraint.

This paper illustrates, with data from real cases, the behaviour of a structurally complex formation excavated at shallow depths. Two cases are presented: the first one is a cut slope while the second is a shallow tunnel excavation.

Slope movements in stiff jointed clays masses, due to the high stiffness of the clay matrix, first develop along discontinuities; this behaviour was observed during the excavation phases of the 20 m high cut hosting the Calipea cut and cover tunnel. When dealing with tunnel excavation, the strong kinematic constraint makes continuous type failure more likely to occur even for low cover. On the other hand, the variable orientation of the exposed front due to the tunnel geometry, favours the development of “discontinuous type failures” in presence of highly persistent geological structures.

Thus, when instability phenomena develop in shallow tunnel, the coexistence of different “discontinuous and continuous failure modes” is possible. The paper also describes the case of Trigoni tunnel whose south side excavation triggered an important instability phenomenon resulting in a severe construction delay and in the need of important improvement works to complete the excavation.

In both the analysed cases, the influence of the structural arrangement of the complex formation has proven to be the critical issue to be considered for the understanding of the observed instabilities and for the most appropriate design of remedial measures.

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