Title : An adaptation of Limit Equilibrium Methods for the design of soil-nailed walls facings

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Abstract :

Soil nailing is a technique developed in France during the 70s for the retaining of excavations. The nails are steel bars introduced in the soil and the soil mass to fail. Today, such structures are often designed through classical slope stability analysis software, *ie* based on Limit Equilibrium. The tension in the nails are generally considered equal to the maximal tensions admissible in the reinforcements. The professionals generally admit that the service loads in the reinforcements are smaller than the calculated ones, especially at the bottom of the excavation because of the construction phasing. This is critical for the design of the facing. In order to know precisely the facing loads, engineers can use Finite Element Method (FEM) but the results are strongly dependent on the stiffness of soil and of the interface between soil and nail. What is more, the FEM is time consuming. Therefore, Limit Equilibrium based software need to be adapted by considering the construction phasing to modulate the mobilization of reinforcements. Based on the study of soil nailed walls through real-scale experiments, centrifuge and numerical modelling, an improvement of the limit equilibrium classical design is proposed. The software used was PROSPER, developped by Laboratoire Central des Ponts et Chaussées in the 90s. The particularity of PROSPER is to derive the reactions of the nail by imposing a displacement of the falling soil mass. This displacement is generally considered as homogenous along the failure surface but considering a high displacement for the top nails (fully mobilized) and a small one for the bottom nails (not mobilized a lot) provides a relevant distribution of soil nail tensions. Abacuses are proposed for the distribution of this displacement and this design approach has been tested on an experimental wall, providing an efficient and time-saving design of soil-nailed walls. It has been implemented in Slog, an open-source software developed in Université Gustave Eiffel.