



Boulders expectation in glacial till tunneling: a transition probability geostatistical approach

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The aim of this study is the prediction of boulder frequency encountered during the construction of a tunnel in a morainic Amphitheater of the northern Po-plain (Italy). This area is characterized by the presence of glacial and fluvio-glacial deposits of Pleistocene age. The ability to predict the size and frequency of boulders during construction is essential for assessing the type of machines to be used for tunneling.

A geostatistical method is proposed herein that utilizes a transition probability-based geostatistical approach (T-PROGS) to model spatial variability of boulders by 3-D Markov Chains. T-PROGS has several advantages over traditional geostatistical methods because has a conceptual framework for incorporating many geological information into the development of simulations. This is accomplished by linking fundamental observable attributes mean lengths, material proportions, anisotropy, and juxtapositioning with Markov chain model parameters.

The geological data base used in this study to compute and constrain the geostatistical simulations consist of: borehole data, geological survey in the excavation, outcrop measurement of boulder characteristics (larger, smaller and intermediate axis, respectively L1, L2 and L3) and an interpretative geological cross-section across the study area.

The result of this study allows us to predict the size and frequency distribution of boulders during the construction of the tunnel. The higher value of boulders is in correspondence of glacial deposits, were a concentration of 27 boulders / 10000 m³ of sediments has been simulated. The variability between different simulations that have been computed have been to quantify the uncertainty existing on the result.