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Design of anti-slide piles for slope stabilization in Wanzhou city, Three Gorges Area, China

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This study is related to the design of anti-slide piles for several landslides in Wanzhou city located in the Three Gorges area. Due to the construction of the Three Gorges Reservoir the hydro-geological conditions in this area have deteriorated significantly, leading to larger instability problems. China has invested a lot of money in slope stabilization measures for the treatment of landslides in the Three Gorges area. One of the methods for the stabilization of large landslides is the design of anti-sliding piles. This paper focuses on extensive slope stability analysis and modeling of the mechanical behavior of the landslide masses, and the parameters required for designing the number, size and dimensions of reinforced concrete stabilization piles. The study focuses on determining the rock parameters, anchor depth, and the pile and soil interaction coefficient. The study aims to provide guidelines for anti-slide pile stabilization works for landslides in the Wanzhou area. The research work contains a number of aspects. First a study is carried out on the distribution of pressures expected on the piles, using two different methods that take into account the expected pore water pressure and seismic acceleration. For the Ercengyan landslide , the Limit Equilibrium Method and Strength Reduction Method of FEM are compared through the results of the landslide pressure distributions on the piles and stress fields in the piles. The second component is the study of the required anchor depth of antislide piles, which is carried out using a statistical analysis with data from 20 landslides that have been controlled with anti-sliding piles. The rock characteristics of the anchor locations were obtained using laboratory tests, and a classification of rock mass quality is made for the anchors of antislide piles. The relationship between the critical anchor height and the angle of the landslide slip surface is determined. Two different methods are presented for the length calculation of the anchor section in case of intensely weathered bedrock. The next component is a study on the subgrade retaining coefficient of anti-slide piles, which includes the definition and experimental methods used. The factors that have influence on the coefficient are discussed and the results of stress calculations in the anti-slide piles for different distributions of subgrade retaining coefficients are presented. Finally the differences between rigid piles and elastic pile are discussed and the elastic piles are considered to be more suitable for the landslide stabilization in the Wan Zhou area. The most important aspects for optimal design is the detailed knowledge of the features of soil and rock around the anchor part, which includes ground coefficients, uniaxial compressive strength, rock mass structure, fractures of bedrock, and weathering degree.