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Rigorous Solution of the Slope Ultimate Bearing Capacity

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Slope stability is the second kind of ultimate equilibrium problem, and the plastic flow equation and the differential equilibrium equation must be solved simultaneously for precise solution, however which can not be realized up to now. So upper and lower bound theorems is one of the effective methods for the approximate solution.

The method of slices for stability analysis first assumes the geometric shape of the slip face and considers the sliding plane is single upon the slope destabilization. However the finite element strength reduction method discloses the mechanics of slope destabilization and is closer to the reality. The method considers that the slope destabilization is decided by plastic strip, not by the single sliding face, and the gliding mass contains the rigid zone and the plastic zone.

Based on the above research, the paper divided the gliding mass into the rigid zone and the plastic zone, and established the discontinuous stress field and velocity field with the upper and lower bound theorems. The three kinds of boundary value problems can be solved with slip-line field method. Firstly the static analysis of slope is completed and the statistic stress field which satisfies the rigid static equilibrium equation can be achieved. Then the associated flow rule is used for dynamic analysis to find the corresponding velocity field. If the velocity field satisfies the velocity condition in rigid zone and other boundary condition, then the solution can be considered precise. Or the new static field should be supposed and the relative static and dynamic analysis followed. Although it will be computed many times, but the numerical solution can satisfy all the stress and the velocity boundary condition, it is an exact solution.

In addition, the influences of the soil properties on the slope bearing capacity are numerically investigated. The computation results show that the approach to solve the limit equilibrium problem is available.

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