THESIS INFORMATION

Title:	**UPPER BOUND LIMIT ANALYSIS OF HOMOGENEOUS SOIL USING THE NODE-BASED SMOOTHED FINITE ELEMENT METHOD (NS-FEM)**
PhD. Student:	**Vo-Minh-Thien**
Major:	**Underground Engineering**
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Training Institute:	**University of Technology, VNU-HCMC**
Scientific Supervisors:	**Associate Prof. Dr. Chau-Ngoc-An**
	Associate Prof. Dr. Nguyen-Minh-Tam

Stability analysis is one of important areas in geotechnical engineering. Examples of stability problems are the determination of bearing capacity of footings, lateral earth thrust on a retaining wall, the safety factor of a slope, stability analysis of tunnels in cohesive-frictional soil in urban areas, etc. Available methods can be used to calculate the limit load such as: limit equilibrium method, slip line method, elasto-plastic by finite element method and limit analysis method.

This thesis presents a new approach for upper bound limit analysis to evaluate the stability of geotechnical problems by using the node-based smoothed finite element method (NS-FEM) and second order cone programming (SOCP). This method is very general, and can deal with homogeneous soil profiles, complicated boundary conditions, and complex loading in plane strain geotechnical problems. The soil is assumed to be perfectly plastic, and it obeys the Mohr-Coulomb failure criterion and associated flow rule. To ensure that the finite element formulation leads to a second order cone programming problem, the Mohr-Coulmb yield criterion in plane strain is formulated as a set of second-order cones. To solve the problems, computer programs are developed in MATLAB, and the toolbox Mosek for conic programming is used.

In this thesis, the upper bound limit analysis using NS-FEM is applied to evaluate the bearing capacity factors N_c, N_q and N_γ of strip footings. The new numerical results are compared with analytical expessions provived by Prandtl (for N_c, N_q factors) and Hansen, Meyerhof, Vesic (for N_γ factors). These expressions are widely used in geotechnical engineering design standard. The obtained results using the present method are compared with other numerical results that have been reported in the literature.

The second part of this thesis is related to the stability analysis of tunnels in plane strain condition such as: circular and square tunnels, dual circular and dual square tunnels subjected to surcharge loading. The influence of the soil weight, the ratio of tunnel size to its depth on the stability numbers and collapse mechanisms are investigated. For dual circular tunnels and dual square tunnels, the distance between centers of two parallel tunnels is the major parameter used to determine the stability.

In the third part of thesis, to show the computational accuracy of the present method, the support pressure on tunnel face and the failure zone in front of circular tunnels in cohesive-frictional soils using the NS-FEM were investigated. The results of this work and the centrifuge model tests by previous authors were compared. Therefore, the present method in this thesis provides a computationally more efficient method for numerical upper bound limit analysis of plane strain geotechnical problems.

Scientific Supervisors **PhD. Student**

Associate Prof. Dr. Chau-Ngoc-An **Vo-Minh-Thien**

Associate Prof. Dr. Nguyen-Minh-Tam