شبكة المعلومات الجامعية
التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم

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جامعة عين شمس

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قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأقراص المدمجة قد أعدت دون أية تغيرات

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AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
STRUCTURAL ENGINEERING DEPARTMENT

STABILIZATION OF EARTH SLOPE USING PILES

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STATEMENT

This thesis is submitted to Ain Shams University for the degree of M.Sc. in Civil Engineering.

The author carried out the work included in this thesis at the Department of Structural Engineering, Faculty of Engineering, Ain Shams University, Cairo, Egypt.

No part of this thesis has been submitted for a degree or a qualification at any other University or Institution.

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Abstract

The stability of earth slopes is a major concern of geotechnical engineers. Various construction activities require analyzing earth slopes such as highway tracks, canals, mining, earth dams, and excavations for foundations' construction.

Failure of earth slopes is always associated with the movement of the human-made fills or natural slopes. Geologists study the cause of natural slope movement and failure. At the same time, Engineers apply the principles of soil mechanics to assess the safety and develop protection and rehabilitation methods to satisfy the serviceability requirements.

Several methods could be used in stabilizing the earth slopes, such as the removal and protection method using excavation and adding a lightweight material, drainage water to decrease the pore water pressure, and reinforcement. If the removal and protection method and water drainage method are not available, reinforcement is recommended to stabilize the slope. Strengthening the slope can be adopted by many approaches: bolts, soil nails, ground anchor, and piles as a supporting element. Using piles has been considered effective and economical.

Piles are positioned either vertically or at an angle to transfer loads from the moving layers to a more stable deep substratum. The piles are installed to the ground by driving them to or drilling them into the holes.

Piles are driven into the ground or placed in drilled holes. The piled slopes' analysis methods are based on the numerical method containing the finite element method, the finite difference method, the traditional method, and the limit equilibrium method.

In this thesis, a numerical study was performed to investigate the efficiency of stabilizing slopes with piles. The verification of the models was divided into two parts. First, a 3D finite element model was developed using PLAXIS 3D V20 and verified with literature. A comparison was then made between the finite element model results and the results using the limit equilibrium method or the finite difference method. Second, another 3D finite element model was verified with a large-scale experimental model made at the University of Missouri-Columbia (2009). A parametric study was then conducted to identify the pile position's effect, inclination, length, configuration, and pile diameter. It also studied the effect of the spacing between the pile on the slope's safety and compared the results with the literature. It was found that the optimum pile's position was in the middle of the slope. The spacing between the piles has a slight effect on the factor of safety, mostly when the piles were near the crest or the toe of the slope. The vertical piles also gave a factor of safety bigger than the piles that are normal to the slope.

Keywords: Numerical analysis, pile, slope stability, factor of safety, pile position, pile direction, 3D finite element, strengthening earth slopes.

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