Chapter 1

Introduction

1.1 Statement and significance of the problem

Landslides, slips, slope instabilities or slope failures are phenomena of the soil movement, which inflict serious damage upon humans. A lot of casualty and lives were being heavily lost yearly. Soil slope failure is the event that can be forecasted efficiently before the occurrence compared with other catastrophes; earthquakes, flood, etc. If there has been a good enough preparation to analyze the cause, and the design, and to modify the process, the risks will decrease (Mairaing, 2000).

Many natural and man-made earth slope stability problems have been faced throughout history. Many methods for analyzing slope stability have been developed, which can be classified as the limit equilibrium method, finite element method, and so on. Methods of slices based on the limit equilibrium theory become the most commonly used methods. Various methods of slices were proposed with different assumptions on the shape of slip surface and the inter-slice forces. The commonly used methods of slices are included Ordinary method of slices (Fellenius, 1936), Bishop's simplified method (Bishop, 1955), Janbu's simplified method (Janbu, 1955, 1973), Morgenstern-Price method (Morgenstern and Price, 1965), Spencer method (Spencer, 1967, 1973), and other limit equilibrium methods. In the other hand, finite element method is a numerical method used the principle of limit analysis. Recently many researches mentioned about such method that can be applied with various complex geotechnical problems since there is no assumption or approximation used in the calculation. However, in many cases, the finite element method cannot be justified because of the insufficiently detailed and inaccurate information to input data.

Geotechnical engineers encountered with so many methods of analyzing stability problems naturally want to know (Duncan, 1996)

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1. "Which of these methods are accurate, which are inaccurate, and for what conditions?"
2. "Which of the accurate methods can be applied most easily?"

A number of comparisons among various methods are presented by Whitman and Bailey (1967), Fredlund and Krahn (1977), Morrison and Greenwood (1989), Cheng (1997) and others, in order to evaluate the accuracy and reliability of these stability analysis methods.

In Thailand, the slope failures sparsely occurred all over the country. Such as; failures of Khong river's banks in the northeastern part, failures of cut slopes in the mountain area of the northern and southern part, etc. More than half of slope failures occurred in the northern region (Yamsai and Mairaing, 2000). The main cause is the slope cutting through the decomposed granite mountain areas. However, serious studies, data collecting of slope failures, suitable methods of analysis, and any case studies in this area are very few.

This study will be first concentrated on verification the various methods of slope stability analysis by comparing the measured and the analyzed normal forces acting on the slip surfaces in model tests. And, furthermore, study on the suitable stability analysis method for earth slope in Northern Thailand by comparing the factor of safety with the actual condition.

1.2 Purpose of the study

To verify the various methods of slope stability analysis in order to obtain the suitable methods for slides in the mountain areas of Northern Thailand.

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1.3 Research scope

1.3.1 The research merely considered 6 slope stability analysis methods included; Fellenius method, Simplified Bishop method, Simplified Janbu method, Spencer's method, Slice-spring method and Rigid bodies-spring method.

1.3.2 A two-dimensional (2D) analysis will be made on the simplified geometry of the slope.

1.3.3 Dynamic aspects and in particular the influence of earthquakes will not be considered.

1.3.4 The data of measuring normal forces acting on the slip surface in the model tests obtained from Laboratory of soil & water conservation, Faculty of Bio-resources, Mie University, Japan.

1.3.5 Analyze of the slope failures which occurred in the mountain areas of Northern Thailand. The research studies only the failure slopes which have rotational slides failure type. Flows type such as; debris flows will not be treated, as well as fall type.

1.4 Research methods

1.4.1 Collect landslide data from the concerned organization. Then, study and analyze the general characteristic of slope failures in Northern Thailand. Furthermore, study the experimentation and gather the data of measuring the normal forces acting on the slip surface in the model tests.

1.4.2 Study and analyze various slope stability analysis methods. This research is primarily concerned with 6 commonly used and rigorous methods of analysis.

a) Fellenius method
b) Simplified Bishop method
c) Simplified Janbu method
d) Spencer's method
e) Slice-spring method
f) Rigid bodies-spring method

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In analysis process, any parameter; unit weight, strength parameter, model shape and loading condition, should be considered and related to the same conditions as the experiments.

1.4.3 Verify the various slope stability analysis methods by comparing the normal forces acting on the slip surface that obtained from the measurement and the analysis

1.4.4 Select the most representative slope failure cases from landslide data and/or site visit. And make field collection of the soil samples in the zone of slope failure in Northern Thailand and then test in laboratory to find the basic properties and shear strength of soils. Standard Penetration Test (SPT) is also included in site investigation to determine the undrained shear strength value roughly. Furthermore, determine the slip surface by sounding methods (dynamics cone test, static cone test) along the slope.

1.4.5 Laboratory works will be conducted on soil samples of the representative slope failure cases. The tests include classification of soils (Atterberg's Limit and Gradation) according ASTM D2487-92 and Triaxial Test (CU: Consolidated-Undrained) with pore water measurement according ASTM D4767-88 in order to determined the effective undrained shear strength parameter. Sometimes, in the case of unexpected samples, the shear strength parameters may be determined in the field by in-situ test (e.g. Standard Penetration Test, Cone Penetration Test).

1.4.6 Analyze the selected slope failures, which occurred in the mountain areas of the northern part of Thailand.

1.4.7 Comparing the results between the model tests and the actual landslide cases. Then, find the suitable methods for this area to be a guideline for geo-technical engineers to analyze slope stability problems.

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