Chapter 6

Conclusion and Recommendation

6.1 Conclusion

From the theoretical part, according to the data of the measured normal forces in the model tests which all shapes of the slip surface is non-circular, the normal force in each slice increases when gaining the surcharge loads at the top of the slope. It is implied that there is the existing of the mutual force between the slice (i.e. the inter-slice force). When compared the measured normal forces and the analytical normal forces given by various slope stability analysis methods, the results show a small variation for general slope case. In the other hand, for more complicated slope case (e.g. slope attached the anchoring force), the difference will be greater. The summations of the normal forces obtained by analysis, with the exception of Fellenius method, are higher than the measured normal forces. It is implied that the factor of safety obtained from these methods might be higher than the actual condition.The results obtained by Slice spring method and Rigid bodies-spring method are very close to the results from the measurement. Thus, these 2 methods give higher accurate than other methods; Spencer method, Simplified Janbu method and Fellenius method respectively.

From the application of various analysis methods of slope stability to several actual slope failure problems in Northern Thailand, Fellenius method highly underestimates the value of factor of safety about 15-40%. Simplified Bishop method which is suitable for circular failure shape gives much different from the expected safety factor (FS=1) about 21.30% in average. Although Janbu's simplified method can apply with any shape of slope failure, it also gives much error about 19.89% in average. Spencer method, Slice spring method and Rigid bodies-spring method, all give high accuracy in the factor of safety than others. The average percentages of difference from the expected factor of safety are 8.63%, 8.48% and 7.29% respectively. But these 3 methods are not conservative, because the trend of the factor of safety is more than 1.0. While other methods are conservative, although the results show much difference from the expected FS.

More than half of landslides in northern area of Thailand has non-circular shape of slip surface, so the slip planes are assumed to be non-circular in the analysis procedure. Spencer method which can apply easier than other accurate methods is therefore suitable to apply in earth

slope problems in this area. However, where the slope angle is being gentle (slope angle, β is less than 20 degrees) or a big load is acting on the slope, Spencer method is not appropriate to adopt because of much error. Under these circumstances, Slice spring method or the methods based on the limit analysis (e.g. Rigid bodies-spring method) are more suitable.

6.2 Recommendation

6.2.1 In the experiment of measuring the normal forces, the effect of the size of model and the variation of slope angle should be considered.

6.2.2 In the next study, when apply to the actual slope failure cases, the sensitivity of groundwater level, shear strength parameter of soil and the number of divided slices should be considered.

6.2.3 Should study the suitable slope stability analysis methods for the actual case of mild slope problems (slope angle, β is less than 20 degrees) in Northern Thailand.