# EFFECTIVENESS OF SUBSURFACE DRAINAGE AND VEGETATION IN ENHANCING THE SLOPE STABILITY: A COMPREHENSIVE CASE STUDY ON BADULUSIRIGAMA LANDSLIDE

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# Statement of Authentication

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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# Abstract

Slope instability, triggered by excessive rainfall, is one of the common geo –hazards that geotechnical engineers are challenged with in tropical countries such as Sri Lanka. Typically, these slope failures are initiated in colluvial layers derived from former landslides or planes of low shear strength in differently weathered zones in the thick soil overburden. Improvement of surface and subsurface drainage has proven to be effective in improving the slope stability by lowering the ground water table as well as preventing near surface perched water table conditions. Badulusirigama Landslide in central highlands of Sri Lanka is an example for a slow moving long rotational slip that activates after heavy rainfall events.

The landslide was rectified with over 45 m long individual sub-horizontal drains that are arranged into a network of radial drainage groups at different elevations along the long sliding mass. This site is also well equipped with monitoring instruments and thus provides a great case history to further our understanding on contribution of surface and subsurface drains in mitigating landslides. In this study, the effectiveness of the introduced subsurface drainage measures in enhancing the stability of the Badulusirigama Landslide was investigated using 2D and 3D numerical models. The numerical models were then used to predict the behaviour of the landslide during different anticipated rainfall events.

The results show that the subsurface drains system enhances the initial near failure condition of the site to a stable slope with a factor of safety of over 1.25 within one month. After initial drop down of the ground water table, the sub-horizontal drains still remain effective by rapidly draining out any infiltration. The analysis also shows that the width of the influence zone of radial horizontal drains should be carefully selected when simplifying the problem into 2D plane strain models because the influence can be very much localised in a low permeable medium. Possibility of introducing surface vegetation as a hybrid measure along with subsurface drainage was also investigated. A factor of safety improvement of 38% and 16.3% was achieved after the simulation of construction of the drains in 2D plane strain and 3D finite element analyses separately. Also, it was found that, vegetation could result in increasing the hydraulic conductivity of the root zone, leading to development of perched water table conditions.

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