STUDY ON SHEAR STRENGTH OF ROOT-SOIL COMPOSITE FOR SLOPE STABILIZATION USING GRASS VEGETATION

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Degree of Master of Engineering

Department of Civil Engineering

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Thesis/Dissertation submitted in partial fulfillment of the requirements for the degree

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DECLARATION

I declare that this is my own work and this thesis/dissertation 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. I retain the right to use this content in whole or part in future works (such as articles or books).

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The above candidate has carried out research for the PhD/MPhil/Masters thesis/dissertation under my supervision. I confirm that the declaration made above by the student is true and correct.

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ABSTRACT

Bio-engineering or utilizing plants to reinforce slopes and prevent erosion, for stabilization of both natural and man-made slopes is a cost-effective and sustainable alternative, especially in developing countries like Sri Lanka. Several factors influence the plant roots' ability to increase shear strength. This study investigates influence of Chrysopogon zizanioides (Vetiver grass) roots on soil's shear strength, focusing on its application in slope stabilization. Shear strength characteristics of soil and soil reinforced with various concentrations of Vetiver grass roots were investigated using large direct shear tests conducted utilizing reconstituted test specimens, to assess their impact on soil shear strength. Stress-strain curves show that, root-reinforced soil exhibit higher shear strength compared to soil-only specimens. Results indicate a proportional increase in shear strength with higher RAR values, with root-permeated soil specimens demonstrating an average shear strength enhancement of approximately 2.5–4 kPa compared to unreinforced specimens, with the increase in RAR up to 1%. The findings suggest that presence of Vetiver roots in soil significantly enhances its shear strength parameters, leading to higher cohesion in root-reinforced soil specimens compared to soil-only specimens. As the RAR increases, indicating a higher density of roots in soil, cohesion of root-reinforced soil specimens also increases proportionally. For the applied normal stress range, observed increase in cohesion of 2 kPa with the increase in RAR up to 1%. Specifically, with a 1% RAR, the study indicates a potential 6% increase in factor of safety, which is a significant improvement of slope stability.

Keywords: Bio-engineering, Chrysopogon zizanioides, Large direct shear test, Slope stabilization

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LIST OF ABBREVIATIONS

Abbreviation	Description
NBRO	National Building Research Organisation
RAR	Root Area Ratio
CSA	Cross Section Area
FEM	Finite Element Modelling
FS	Factor of Safety

LIST OF APPENDICES