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ORIGINAL PAPER

Effect of *Alstonia Angustiloba* tree moisture absorption on the stabilization of unsaturated residual soil slope

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Abstract
In this study, the investigation on the influence of *Alstonia Angustiloba* tree moisture absorption at various depths and separation on the development of persuaded moisture absorption in soil were performed. The slope stabilization analysis were conducted considering two conditions (dry and wet conditions) at two different slope (saturated and unsaturated slope). Besides, the tree moisture absorption data generated during the course of 8 months of on-site monitoring are recorded and applied to assess the safety factor of the slope. Slope stabilization analysis is then performed and represented in two-dimensional and three-dimensional contour model to investigate the effect of plant transpiration on the slope stabilization. According to the findings, at the slope crest with the existence of *Alstonia Angustiloba* tree, the tree moisture absorption recorded a maximum value, at a distance and depth of 1.1 and 0.25 m. Moreover, the findings also proved that larger tree moisture absorption enhanced the slope's safety factor by up to 53% (from 2.17 to 4.57). The tree moisture absorption can provide an environmentally benign technique that can be used globally to avert slope disaster.

Keywords Factor of safety · Rainfall infiltration · Shear strength · Slope stability · Tree-induced suction

Introduction

Residual soil is the most widespread in tropical areas where frequent precipitation and moderate temperatures may encourage erosion (Zolkepli et al. 2021a; Zolkepli et al. 2021b). Microstructure and mineralogical composition are the important characteristics that may contribute to the specific qualities of residuals soil (Schiavon et al. 2019; Hasan et al. 2021a, b, c, d; Zaini and Hasan 2023a, 2023). Various disasters such as landslip may be attributed to the weakness in various engineering characteristics of this soil (Oberhollenzer et al. 2018), especially the carrying capacity and strength of the soil (Zhang et. al., 2022; Zaini and Hasan 2023a; 2023). Landslip may be accomplished by a single or combination of motions such as running, sliding, and collapsing (Zaini et al. 2020a, 2022a), and it has piqued the attention of civil engineering researchers owing to the significant deflation (Goh et al. 2020; Zaini et al. 2020b).

Slope disintegrate on various types of slopes is significant because it threatened lives, leading to deflation, and degrades the climate (Ishak & Zaini 2018). Territorial communities and visitors are always exposed to the natural calamities such as overflowing, torrents, and wildfire (Pradhan & Siddique 2020). For the last 70 years, the issue of slope stabilization has been a cornerstone of research in the geological engineering profession and academia. Numerous methodologies proposed in accordance with current computational approaches have been rectified in order to achieve maturity in the engineering community (Hasan et al. 2021b; Zolkepli et al. 2021a; Bouzid 2022). However, there is no commonly accepted clarification for the safety factor. The safety factor is widely computerized for most slope stability problems based on the assumption of highest bearing load capability. Nonetheless, it is easier for slope stability calculations if the safety factor is linked to the usual strength properties of the soil (Awang et al. 2021).

Slope stabilization issues have piqued the interest of scientists all over the world, and as a result, several methodologies and application for evaluating the slope stabilization have been created (Chen et al. 2013; Zaini et al. 2019). Slope stabilization

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