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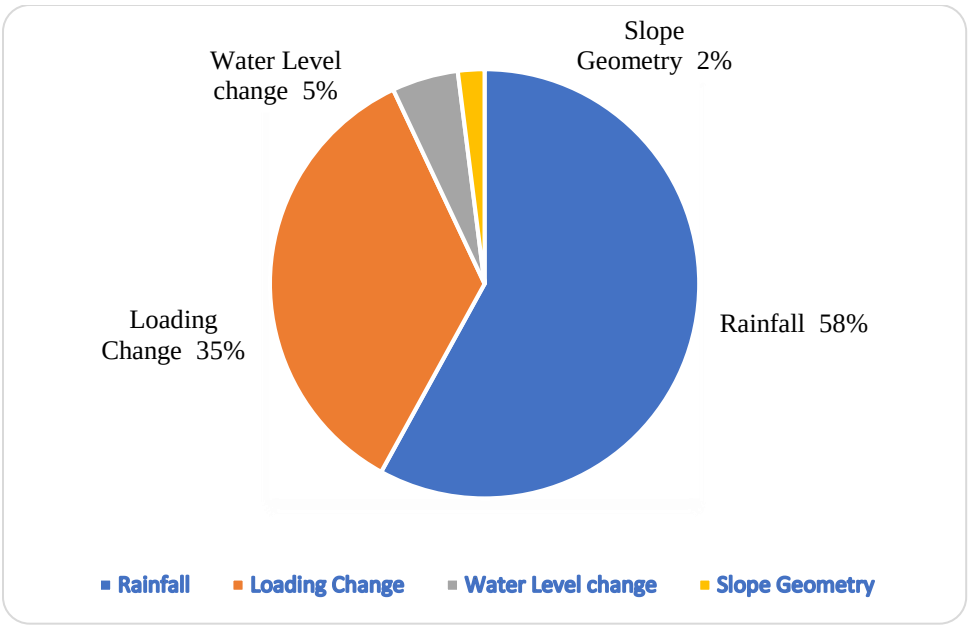
PhD Research Title

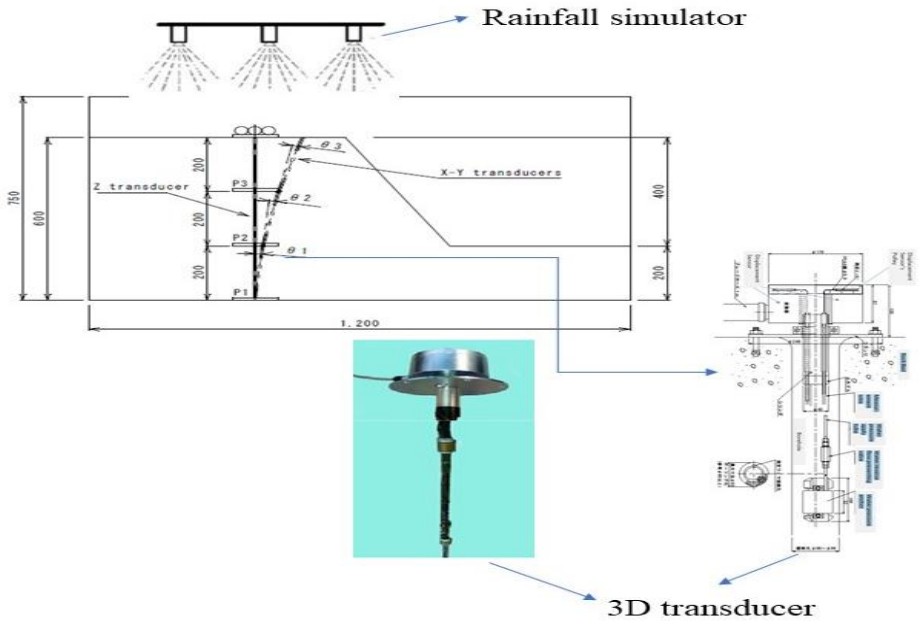
3D Physical-Numerical Model for Threshold Strain Level in Slope Instability

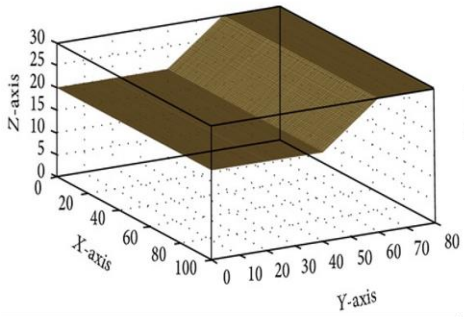
Executive Summary

Slope instability has been a major problem for human beings. Slope instability due to rainfall is more prominent and most important triggering factors in tropical regions which receive frequent rainfall over the year. With global climate change, there is a significant increase in longer duration rainfall event which has a detrimental effect on slope stability. As rainfall water infiltrate the soil slope, it results in the rise of groundwater level, reduction in matric suction and increase in pore water pressure, thus decreasing the shear strength of the soil which ultimately lead to the slope failure. Thus, it is important to relate shear deformation and slope instability of fine-grained soil to a critical value of pore pressure above which the soil fails. The conventional instrumentation used for slope monitoring measure the deformations in two directions and utilize casing for instrument installation makes them less sensitive.

This study aims to characterize threshold shear strain level and pore water pressure at which soil slope fails and to understand the failure mechanism in three directions. This will be achieved by establishing a laboratory scale slope model, which will be subjected to artificial rainfall by rainfall simulator. New insight 3D transducer will be utilized which can monitor the deformation in 3 direction. Furthermore, the slope model will be simulated in 3D Finite Element Analysis (FEA) software to gain in-depth understanding of the failure mechanism in the modeled slope. A robust combination of laboratory and numerical models will successfully examine the influence of threshold strain level which will help in characterizing new approach in identifying the slope instability behavior, which may be incorporated in the National Slope Master Plan. It is very important to characterize the threshold strain level which can be used as a warning guideline for the future slope monitoring system in the tropical countries.


Slope
Geometry 2%
Water Level
change 5%
Loading
Change 35%
Rainfall 58%
Rainfall
Loading Change
Water Level change
Slope Geometry


Rainfall simulator
Z transducer
X-Y transducers
P1
P2
P3
1,200
3D transducer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X-axis
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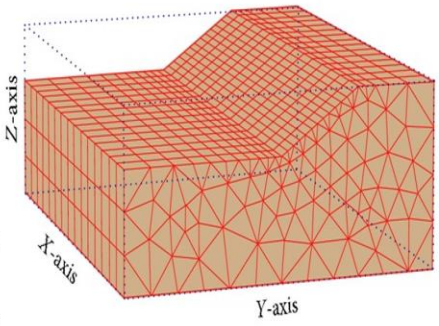
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