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NUMERICAL STUDY OF STABILITY OF SLOPE BY PLAXIS 2D

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ABSTRACT:
Stability of slope is one of the most important sectors which should be addressed properly in the area of geotechnical engineering. The main purpose of this study is to determine the horizontal deformation as well as vertical deformation for the given angle of slope of the soil. This stability analysis of the slope has been done here by finite element method using PLAXIS 2D. In this study different types of sequence modelling were conducted here. Every sequence of the model was to investigate for the stability analysis purpose with various frequency and Amplitude taken into account. The effect of various frequency levels, Base shaking are studied. Using PLAXIS the numerical model was developed for soil slope. The result of this study shows the different values of factor of safety for different sequence with various frequency and acceleration.
Key words: - Soil slope, Plaxis 2D, Dynamic Loading, Numerical analysis. Frequency, Amplitude

INTRODUCTION:

Slope stability refers to the condition of inclined soil or rock slopes to withstand or undergo movement. Slope stability analysis is a static or dynamic, analytical or empirical method to evaluate the stability or earth or rock fill dams, embankments, excavated slopes, and natural slope in soil and rock. The stability condition of slopes is a subject of study and research in soil mechanics, geotechnical engineering and engineering geology. Stability of slopes is one of the peculiar and practical issues for researchers and has attracted an extensive attention. Generally, different methods of slope stability applied by geotechnical researchers are classified into experimental, numerical and analytical categories.

There are two basic methods available for slope stability analysis: Limit equilibrium method (LEM) and Finite element method (FEM). The principal difference between these two analyses is that the LEM is based on the static of equilibrium and FEM is based on the stress-strain relationship. The FEM was first introduce into geotechnical engineering by Clough and Woodward in 1997. The FEM is a great tool to solve geotechnical problems due to its ability to model nonlinear stress-strain behavior of materials. The finite element method (FEM) is a widely used method for numerically solving differential equations arising in engineering and mathematical modeling. Typical problem areas of interest include the traditional fields of structural analysis, heat transfer, fluid flow, mass transport, and electromagnetic potential. The FEM is a general numerical method for solving partial differential equations in two or three space variables.

FEM is best understood from its practical application, known as finite element analysis (FEA). FEA as applied in engineering is a computational tool for performing engineering analysis. It includes the use of mesh generation techniques for dividing a complex problem into small elements, as well as the use of software program coded with FEM algorithm. In applying FEA, the complex problem is usually a physical system with the underlying physics such as the Euler–Bernoulli beam equation, the heat equation, or the Navier-Stokes equations expressed in either PDE or integral equations, while the divided small elements of the complex problem represent different areas in the physical system.

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Nowadays everything advanced and lot of possibilities to use software. In that PLAXIS 2D is advanced software suitable for solving geotechnical problems based on traditional analytical method and finite element method. PLAXIS-2D is a computer programme that performs finite element analysis (FEA) within the realm of geotechnical engineering, including deformation, stability and water flow. The input procedures enables the enhanced output facilities provide a detailed presentation of computational results.

The focus of this paper is on Numerical Study of Stability of slope using measurement from a series of set up of systematically sequence set of soil slope monitored for Finite Element programme by PLAXIS-2D is used here to predict the performance of the slope. In this study no inclusion of any kind of soil reinforcement considered. The purpose of this study is to determine the factor of safety for allowable displacement by stability analysis which has been done by Finite Element Method using PLAXIS-2D.

METHODOLOGY

1) Geometry of the finite element model slope

Firstly, a mixed soil with 15m height, and width= 40m and slope height=30m respectively as presented in the below figure, was invested in this study. The fill and entire soil material were modelled as Mohr-coulomb.

General Parameters	
Material set	Common for all variable sets
Material model	Mohr-Coulomb model
Material type	Drained condition

2) Material properties

The below table states the soil properties used in the PLAXIS-2D modelling where the Cohesive strength (C), the angle of Internal friction ($_{\varphi}$), the density, permeability co-efficient, Elastic modulus, other parameters are kept constant for all variable data set respectively in all stages of these analysis.

Parameter	Value
$_{y\ unsat}$	18KN/m^3
y_{sat}	20KN/m^3
K_y	0.0001m/day
K_x	0.0001m/day
E_{ref}	50,000KN/m^3
C_{ref}	0 KN/m^3
$_{\varphi}$	40 degrees

3) Method

The Stability analysis of soil slope has been done by Finite Element method using PLAXIS-2D. The Mohr-Coulomb model was used as the analysis of the problem considered. Here different slope height and slope angle and the combination of both considered here where we got the Displacement and Factor of safety.

4) Variable inputs

DISCUSSION:

The numerical simulation techniques adopted in this paper which is captured the overall behavior of the stability of the soil slope. The important simulation consideration in the Finite Element Model analysis is the selection of appropriate parameters. The deformation mesh and factor of safety are obtained from software using PLAXIS-2D. The observed sloped surface settlements are plotted here with the determined value of Factor of Safety for different slope heights.

CONCLUSION :

An expected from output data, the surface settlement safety of soil slope from PLAXIS-2D FEM analysis agreed well with data.

Cohesion (c) and friction angle ($_{\varphi}$) as resistance forces are directly related to the safety factors.

Calculation accuracy of the methodology is verified for cohesion soil material alternatives and drained conditions.

The computed slope surface the beginning is higher value of factory of safety and it simultaneously decreased with increase of slope height.

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PLAXIS-2D Version 20.0.0.0.0

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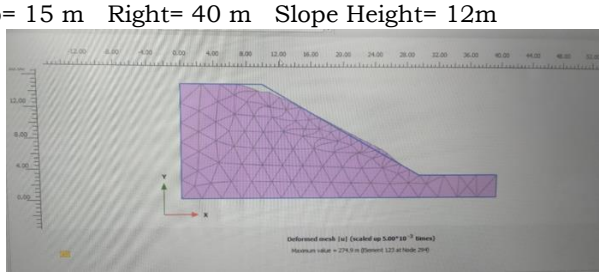
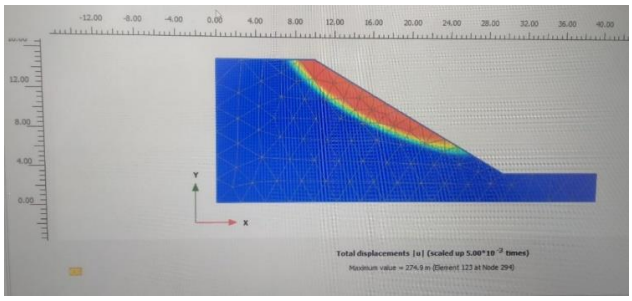
Original

Slope 1

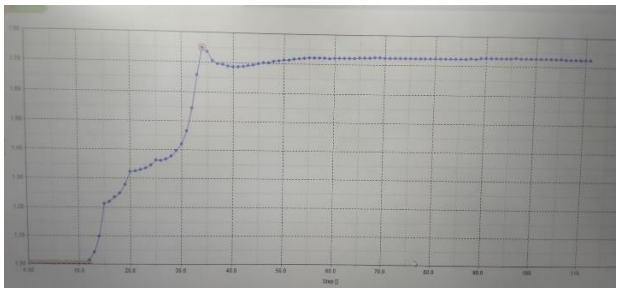
Top= 15 m Right= 40 m Slope Height= 12m



Deformed Mesh



Total Displacement



Factor of Safety of slope 1

Factor of safety =1.725

Slope 2

Top= 15 m Right= 40 m Slope Height= 10m

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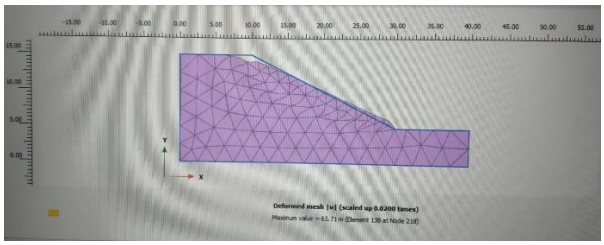

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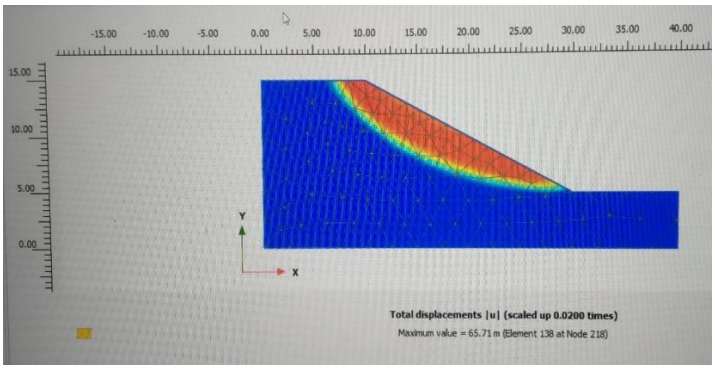
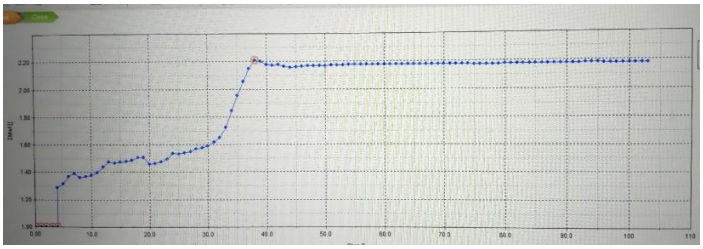


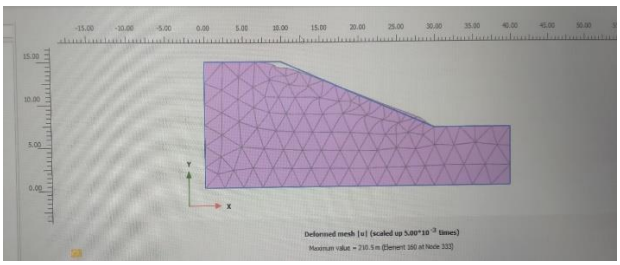
Total Displacement



Factor of Safety of Slope 2
Factor of safety =2.177

Slope 3

Top= 15 m Right= 40 m Slope Height=8 m



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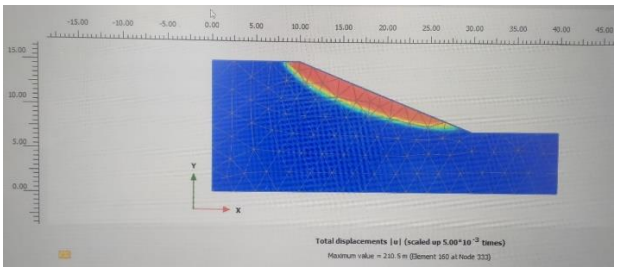
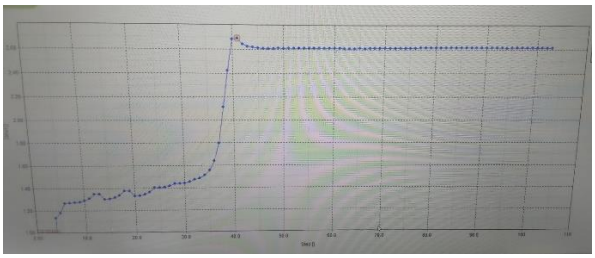
Deformed Mesh



Total Displacement



Factor of Safety of Slope 3

Factor of safety =2.748