International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 5, Issue 03, March-2019

NUMERICAL ANALYSIS OF THE SLOPE BY GEO5

Ekta Patel[1], Assistant Prof. Bhoomi kamdar[2], Dr.Nitin joshi[3]

[1]*Dept. of Civil Engineering & Parul Institute of Technology Vadodara,*
[2] *Dept. of Civil Engineering & Parul Institute of Technology Vadodara,*
[3]*Dept. of Civil Engineering & MSU Vadodara,*

Abstract— failure of the slope often costs lives as well as property. Numerical simulation performed with GEO 5 software to know the influence of anchor for slope stability by traditional Limit Equilibrium method; Bishop's method. For the analysis silty sand is used; for the given slope, the best inclination of the anchor is suggested to be 25° from the horizontal. optimal horizontal spacing between anchor is determined to be 0.5m to 1.3m. optimal capacity of the anchor should be 200KN to 350KN.

Keywords— Geo5, slope stability, anchored slope, Bishops method, numerical analysis:

I. INTRODUCTION

A man-made slope is an unsupported, inclined surface of a soil mass. Earth slopes are formed for railway formations, highway embankments, earth dams, canal banks, levees, and at many other locations.
The cost of earth work would be minimum if the slopes are made steepest. However, very steep slopes may not be stable. A compromise has to be made between economy and safety, and the slope provides are neither too steep nor too flat. In other word, the steepest slopes which are stable and safe should be provided.
The failure of slop may lead to considerable loss of life and properties. It is, therefore, essential to check the stability of proposed slopes. With the development of modern methods of testing of soils and stability analysis, a safe and economical design of a slope is possible. The geotechnical engineer should have a thorough knowledge of the various methods for checking the stability.
Analying the stability of earth structure is the oldest type of numerical analysis in the geotechnical engineering. Even to this day, Stability analyses are by far the most common type of numerical analysis in the geotechnical engineering. Stability is a key issue in any project- Will the structure remain stable or collapse?

II. RESULT AND ANALYSIS

Discussion on Effects of Anchor Parameter
Properties of the material (soil) considered in the present study is shown in table1.

Table 1 material (soil) used in the present study

Soil parameters	value
Unit weight, Υ	18 KN/m^3
Angle of friction, $Ø_{ef}$	29 degree
Cohesion, c_{ef}	5 KPa
Saturated unit weight, Υ_{sat}	20 KN/m^3

Firstly analysis of unanchored slope with varying slope has been performed to know the relation between unanchored slope with horizontal and the FOS and the rate of decrease of FOS decreases with increase in the slope of soil. For the future slope stability analysis, to know the influence of anchored parameter 80 degree slope was taken.

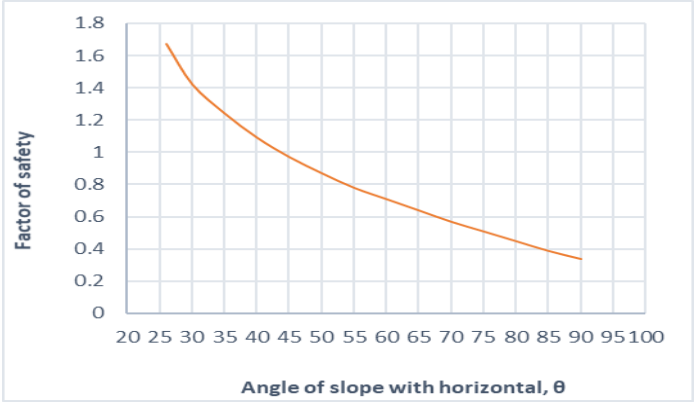

Fig. 1 Graph of FOS versus angle of slope with horizontal

A. *Influence of length of anchor*
The input parameters are as follows

Angle of Slope with horizontal, θ - 80 degree
Method of Analysis - Bishop

Table 2 properties of anchor

Number of layers	3 layers
Length, l	**Variable**
Angle with horizontal, α	0 degree
Horizontal spacing, b	1.0
Capacity of anchor, F	200KN

Different length of anchor l= 3, 3.5, 4, ..9m are specified in numerical simulation. By putting above parameters the relation between factor of safety and length of anchor is obtain. The graph of this relation is shown in figure 2. The rate of increase of FOS decreases with increase in the length of anchors

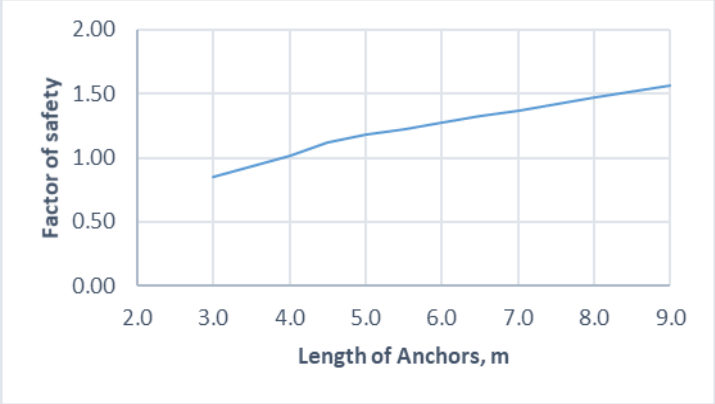

Fig. 1 Graph of FOS vesus length of anchor

B. *Influence of alpha*
Alpha is the angle of the slope with the horizontal. Safeth factor with the inclination of 0, 5, 10,..35are calculated respectively and the relationship curve between safety factor ang ancor inclination is ploted in figure FOS increases with increase in angle of inclination up to 25 degree and thereafter it decreases with further increase in angle of inclination of anchors.

Table 3 properties of anchor

Number of layers	3 layers
Length, l	3.0 m
Angle with horizontal, α	**Variable**
Horizontal spacing, b	1.0
Capacity of anchor, F	200kN

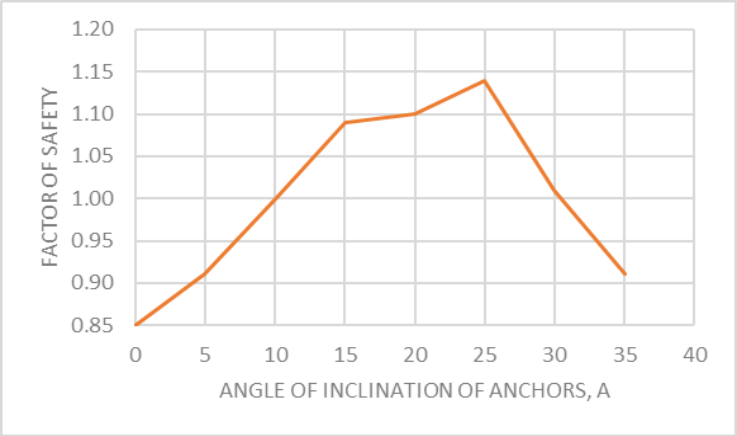

Fig. 3 Graph of FOS versus angle of inclination of anchores

C. *Influence of horizontal spacing between anchor*

Slope stability is studied with different horizontal spacing of anchor and the result is shown in figure and it shows that FOS remains constant up to horizontal spacing of 1.3 m and thereafter it decreases with further increase in spacing of anchors.

Table 3 properties of anchor

Number of layers	3 layers
Length, l	6.0 m
Angle with horizontal, α	0 degree
Horizontal spacing, b	**Variable**
Capacity of anchor, F	200kN

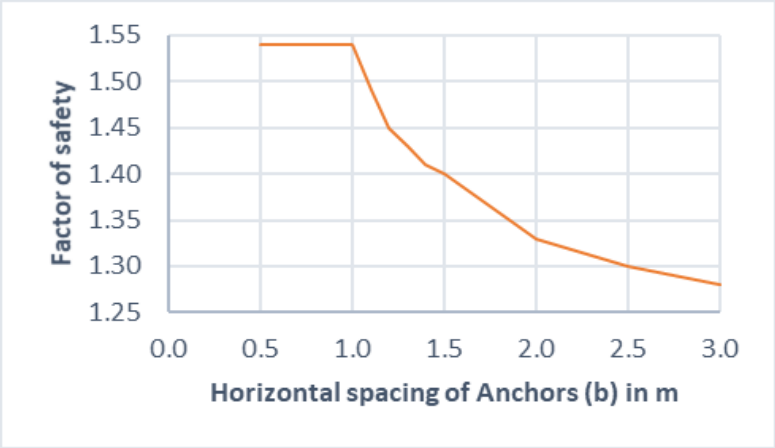

Fig. 4 Graph of FOS vesus horizontal spacing of anchor

D. *Influence of Anchor Capacity*

As the capacity of anchors increases, FOS also increases. There is no further increase in FOS as the capacity of anchors increases 250 KN.

Table 3 properties of anchor

Number of layers	3 layers
Length, l	5.5 m
Angle with horizontal, α	0 degree
Horizontal spacing, b	1.0 m
Capacity of anchor, F	**Variable**

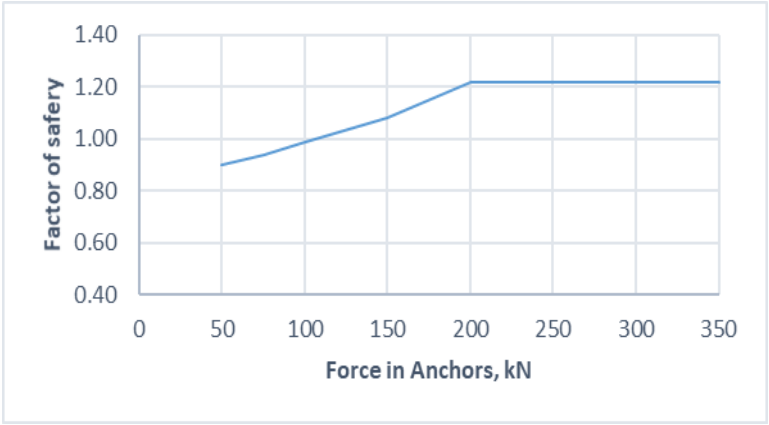

Fig. 5 Graph of FOS versus force in anchor

III. CONCLUSIONS

A numerical study is carried out to investigate the effect of the anchor parameter like length of anchor, horizontal spacing of anchor, inclination of the anchor and the capacity of anchor on the factor of safety by using Bishops method. for the study 10m height of slope and silty sand is used. some of the important finding of the study are summarized bellow:

i. The stability of the slope increases with the increase in the length of the anchor.
ii. The stability of the slope increases with increase in angle of inclination up to 25° and thereafter it decreases with further increase in angle of inclination of anchors.
iii. The stability of the slope remains constant up to horizontal spacing of 1.3 m and thereafter it decreases with further increase in spacing of anchors.
iv. As the capacity of anchors increases, the slope stability also increases. There is no further increase in the stability of the slope as the capacity of anchors increases 250 KN.

REFERENCES

[1] Y. G.-l. L. X.-h. FANG Wei1, "Spatial Optimization of Anchors for Slope Stabilization," in *GeoHuman International Conference* , 2011.

[2] *. Slávka Harabinováa, "Assessment of Slope Stability on the Road," *ScienceDirect*, vol. 190, p. 390 – 397, 2017.

[3] F. I. R. a. M. A. A. M. Md. M Sazzad1, "EFFECTS OF WATER-LEVEL VARIATION ON THE STABILITY OF SLOPE BY," in *International Conference on Civil Engineering for Sustainable Development*, Bangladesh, 2016.

[4] I. M. M. Nicoleta M. Ilies*1, "Underground Houses on Sliding Slopes," *Acta Technica Napocensis:*, vol. 57, no. 2, 2014.