SLOPE STABILITY OF EARTHEN DAMS BY USING GEOSTUDIO SOFTWARE

Author: [1]Vaibhav Mahakal [2] Siddhesh Kulkarni[3] Chaitanya Deore[4] ZaidManiyar [5]Prof. Ganesh Gujrathi (Guide)

Abstract:

GEOSTUDIO software is mostly used in various civil engineering applications and their problem analysis by considering different consideration. Now a days it's widely used this area mostly for finite element analysis, slope stability, seepage analysis and so on other applications. SLOPE/W is a component of a complete suite of geotechnical products called Geo-Studio. SLOPE/W is the leading slope stability CAD software product for computing the factor of safety of earth and rock slopes. SLOPE/W can effectively analyze both simple and complex problems.

Introduction

An earth dam is built in layers of material, 150 to 450 mm thick, which are compacted with vibrating or heavy machinery. The material has to have a moisture content close to its 'optimum' value to achieve maximum in-situ density. Soils that need to be flexible, such as the core material are usually compacted slightly wet of the optimum. If the soil is too wet, the compaction is ineffective and the plant cannot operate. Soil used in the shoulders is often stiffer and, to achieve this, the placement water content is at or just below the optimum value. At the other end of the range, if the soil is too dry, effective compaction cannot be achieved. Control testing of the fill materials, both at the borrow pit and after placement is necessary to ensure compliance. Slope stability is an important aspect of geotechnical engineering. The uses of finite element analysis of slope stability and seepage have gained popularity in recent years due to its capability to handle complex problems. Slope stability and seepage analysis of earth dam is very important to ascertain the stability of the structure. The stability of earth dam depends on its geometry, its components, materials, properties of each component and the forces to which it is subjected. The design of earth dams involves many considerations that must be examined before initiating detailed stability analyses. Such as geological and subsurface explorations, the earthand/or rock-fill materials available for construction should be carefully studied. The slopes are of two types: 1. Natural Slope 2. Man-made Slope. The natural slopes are those that exist in nature and are formed by natural causes. Such slopes exist in hilly areas. Generally, slopes are maintained in the construction of highways, railway canals, and river-training works, etc. and the slopes of the earthen dams are examples of finite slopes which are called manmade. The slope length depends on the height of the dam or embankment. Example: Landslides. Detection of Slope stability is an important term of geology. In general, linear problems such as the prediction of settlements and deformations, the estimation of flow quantities due to steady and transient seepage are all more susceptible to answer by finite elements. The uses of finite element method for slope stability and seepage have attain name in recent years due to its capability to handle critical condition. The initial and main focus of this research is to study the effect of various water levels to the dam slope by using finite element method, and to determine failure mechanism. Slope stability and SLOPE STABILITY OF EARTHEN DAMS BY USING GEOSTUDIO SOFTWARE Guru Gobind Singh Polytechnic, Nashik – 422 009 (2022-23) 2 seepage analysis using technology such as computersare easy task for engineers when the slope configuration and the

soil parameters are well known. However, the selection of the slope stability analysis is not an easy task and the field conditions should be collected and the failure observations in order to know the failure mechanism, which gives the slope stability method that, should be used in the analysis. Therefore, the theoretical background of each slope stability method should be investigated in order to analyse the slope failure and assess the reliability of their results. Two-dimensional slope stability is mostly used method in the engineer due to their easiness. Geostudio software is one of the popular geotechnical software based on the finite element and can also do the analysis like stress-strain, seepage, slope stability, dynamic analysis andwater drawdown in the reservoir.

Methodology

Software analysis is done on Kashypi Dam. The analysis is done by Morgenstern-price method. The data which is required for analysis is collected from Irrigation Department
(MERI) for soil. For solving the analysis literature is used with Geostudio help

Matarial used

The student version of SLOPE/W only allows analysis of materials with the Mohr-Coulomb properties

1. Unit Weight (kN/m')
2. Cohesion (kPa)
3. Friction Angle (Degree).

The student version limits the analysis to 3 materials only.

Data Of Kashypi Dam

1. Official name- Kashypi Dam D03105
2. Location – Rajapur
3. Type of dam- Earthfill
4. Impounds –Kashyapi river 5. Height -41.75 m (137.0 ft) 6. Length -1,291 m (4,236 ft)
7. Dam volume -0.002761 km3 (0.000662 cu m)
8. Reservoir

9. Total capacity -0.05269 km3 (0.01264cu m)

10. Surface area- 46.1 km2 (17.8 sq m)

0 SLOPE/W Analysis steps :

1. For slope stability open the Geo StudioSLOPE/W Define module
2. Identify the individual toolbarsavailable.
3. Set the working area.
4. To set the working page size.
5. Set the scale.
6. Sketch a picture.
7. Set and display the grid.
8. To save the data to a file.
9. To sketch an axis.
10. Sketch the slope stability problem
11. Specify the analysis methods.
12. Specify the options used in theanalysis.
13. Define the soil properties.
14. Draw the first region of the problem.
15. Draw entry and exit location
16. Turn off the points and the pointnumbers.
17. Display soil properties.
18. Verify the problem.
19. Save and analyse the problem.
20. Viewing the results.

Results

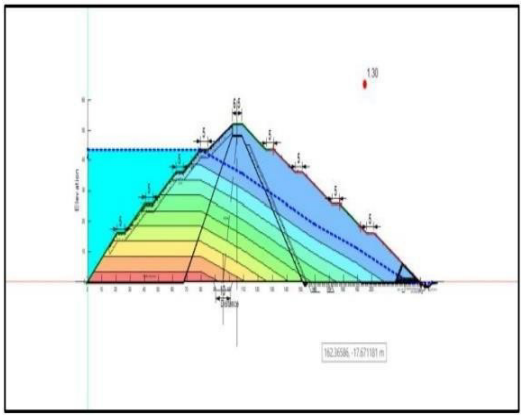

Fig no.1: SLOPE/W Model Showing FOS

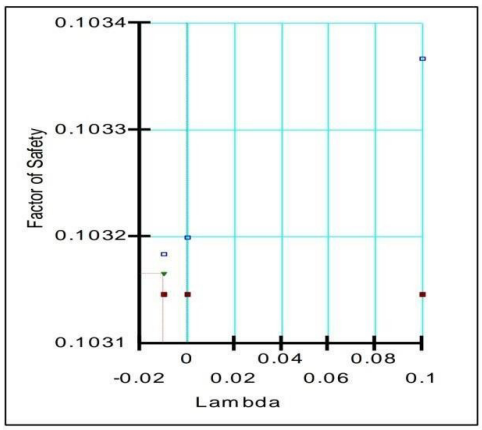

Fig no.2 factor of safety

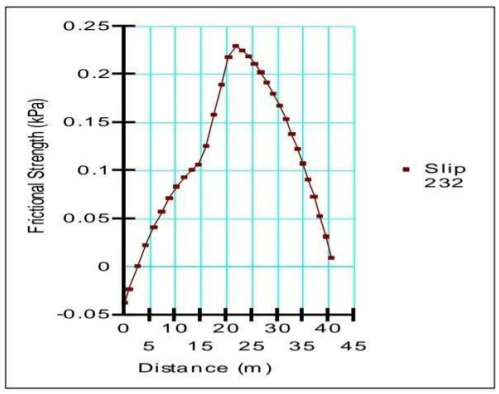

Fig no.3: Distance Vs Frictional Strength

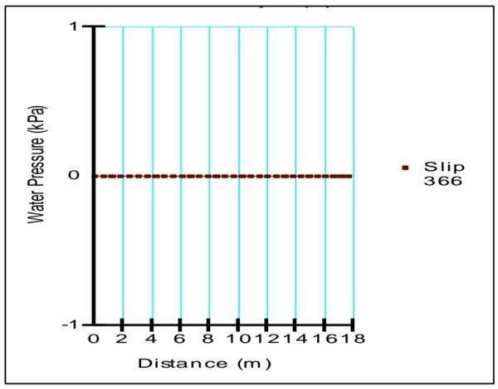

Fig no.4: Distance Vs Water Pressure

Objectives of the study

The main objectives of slope stability determination are finding endangered location, investigation of potential strong failure mechanisms. Estimation of the slope sensitivity to different triggering mechanisms, designing of optimum slopes with required to safety. Better design of the slope requires geotechnical knowledge and site characteristics. Choice of correct analysis method depends on both side situation and the mode of failure.

CONCLUSION

1. The value of FOS evaluated using Geo-Studio is more reliable as compared to the limit equilibrium method. In Geo-Studio, it is easy to undertake the parametric sensitivity studies.
2. Provision of drain increases the factor of safety on downstream side.
3. Steady state sudden drawdown stability analysis on downstream side is necessary for homogeneous earthen dam.
4. In this analysis, the factor of safety values form Morgenstern-Price method have been analysed to find out stability of earthen dam, which are analysed with berm with drain case at Entry and Exit.
5. As per IS Code 7894 (1975) for determining the FOS of earth dam minimum FOS should be considered

i.e. 1.3 to 1.5.

Reference

1. Vahidnourani, Structural Geology Algorithms: Vectors and Tensors in Structural Geology: New York, Cambridge University Press, Journal of the Soil stability Division, ASCE, vol.81 , No. SM 4, Proc. Paper 4431, oct 1969, pp. 15-120.
2. H. Hasani, J. Mamizadeh H. Karimi, Geological Society of America SpecialPaper 269, 2 march 1991, 41 p.
3. Kamanbedast and.

Delvarit,"Three- dimensional stratigraphic evolution of the Miocene Baltimore Canyon region: Implications for eustatic interpretations and the systems tract model". Geological Society of America Bulletin, vol.45, Jan 1998, pp1-15

4. Meysam Alinaghiana, Kourosh Shahriarb, "Material transfer inaccretionary wedges from analysis of a systematic series of analog experiments". Journal of Structural Geology. Nov.1992, Page no 401 (4): pp 407–416.

5. Kamran Goshtasbic et al.,Principles and applications of geochemistry: a comprehensive textbook for geology students. Upper Saddle River, NJ:, feb 1996 page no. 678 , PrenticeHall. ISBN 978-0-02-336450-1.

6. Henry Darcy (1856), "Stability Analysis of Embankments', Journal of the Soil Mechanics and Foundations Division, ASCE, vol.93, No. SM 4, Proc. Paper 5305, July 1967, pp. 1- 33.