Available online at www.elixirpublishers.com (Elixir International Journal)

Civil Engineering

Elixir Civil Engg. 107 (2017) 47013-47015

ISSN: 2229-712X

Arching Phenomenon Check with the Finite Element Method in Tang-e Hamam Dam and Compared With the Precise Instrumentation Results of Dam

Noshad Yousefpour

Department of Civil engineering, Hamedan Branch, Islamic Azad University, Iran.

ARTICLE INFO

Article history:

Received: 2 May 2017;

Received in revised form:

27 May 2017;

Accepted: 7 June 2017;

Keywords

Earth dam,
Clay core,
Arching,
Confidence Factor,
Case Study,
The finite element method.

ABSTRACT

Analysis of earth dams Stability, and their arching phenomenon, is one of the most important issues in geotechnical engineering. Arching dam, you can use one or more methods are analyzed. The main factor of instability dams, gravity effect, but other factors can, intensify or provoke them to be effective. To understand the factors intensifying landslide, could contribute significantly to the experts, and the stability of the dam dirt, and prevent the arching. The purpose of this paper is to examine the phenomenon of arching in the bathroom tight barrier with finite element method, and compared with studies of dam instrumentation, numerical analysis by finite element software PLAXIS, has been made. Analysis, using behavioral models Mohr-Coulomb, is done. On the other hand, we can say that, numerical methods in the analytical methods is very rapid, reliable and accurate, and therefore these methods, able to perform parametric studies, the boundary conditions are complex. So in this study, AH stresses dam Tang-e Hamam, has been studied, and then perform parametric studies, it was concluded that increasing the angle of internal friction shell dam, the dam will lead to increased confidence. However, by changing the geometry of the dam core, core thickness miles to miles and increase confidence rises Dam. Also, the arching, the barrier height is variable, and strongly arching and the maximum arching, core thickness depends on the height of the dam.

Introduction

In order to save, and set the border river Qurehto and Jagiran, on the Iranian border with Iraq, and its use in irrigation runoff, Reservoir Dam Tang-e Hamam, has been introduced. Based study Reservoir Dam Tang-e Hamam at 17 km East of the city of Qasr-e Shirin, and are less than a kilometer from the Iraqi border, is located.

This is based on Qurehto River, and approximately 1400 m downstream junction Jagiran River, is located. Experience in the destruction of dams, although tragic, but warnings are effective, justified the proposed additional precaution, and the result quick Find it reduces the number of injuries, and the destruction of dams. Added experiences are many and varied, Analysis of the performance of dams, and compares the results with the software, the emergence of methods and calculations are incredibly detailed, gathering results of laboratory tests, the behavior of materials used in the construction of dams, dialogues and Consultation experts with each other, getting to the elimination of ambiguities and clarify the behavior of the dam has expanded, and so, fortunately, this industry is very important in recent years in Iran, activity slowed considerably, and increasing its future is also very is promising. Dams may be homogeneous, stratified, Aperture, the cores miles or covering upstream, and from the perspective of a method of making almost all of them, now ramming are but a few of the type of hydraulic called (dams short rivers in the past, and dams of tailings at the present time), rockfill dam, which, of them the same types of dams, may be matched with concrete covers upstream, (CFRD), or a core of clay vast central core Rossi mile or central diaphragm made. according to the problems associated with impermeable materials, the core of earth dams, as well as the Combination of other problems, the earth dam with clay core, the debate about the type and thickness of the clay core is raised. The groundwork for the destruction and the phenomenon of arching it provides that, should the dams of pore water pressure inside the core, and during that, as a result of a gradual increase in dam height may occur, as always engineers should be considered. Tools of the dam, and Behavioral it during the build, it does not help much, so that may be a temporary separation barrier, in some stages of construction of the proposed [5]. During various stages of construction of a dam, it is possible that, given the conditions created for dam constructions to different behaviors, to show that we can block the function of each of the different areas, such as core-shell , foundations, etc., using the monitoring, examined, and measures to strengthen and reform the problems facing them, considered [6]. Because arching phenomena in clay core, total vertical stress in the core decreases. Reducing the vertical stress in the core leads to hydraulic fracturing, occurs at the dam. The control arching phenomenon at the core of the utmost importance.

With the advancement of algorithms, such as finite difference methods, and finite element numerical analysis substitute for analysis are classic.

With the increasing capabilities of these methods for modeling components and different environment, to consider the interaction of different environments on each other there, and more reliable results than the classic method gives. Now, the earthen dam stability analysis, using computer software, considerable progress has, and especially the use of finite element method, a substantial embankment dam stability analysis, has been developed. In some analysis, solution to the problem of slope stability, usually in terms of the critical height of slope [3], the time limit used in some parts of the border slope [4] expressed. If there is no load limit, the collapse of its own weight through the soil may be caused. Hence, the extreme conditions in terms of soil unit weight, is expressed. [1]

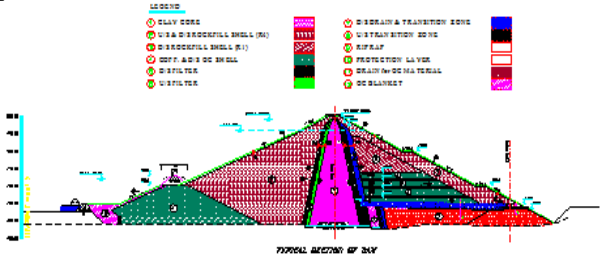

Figure 1. doby segment of Tang-e Hamam dam.

Method

The purpose of this paper is to examine the phenomenon of arching in Tang-e Hamam dam with the finite element method, and compare the results with data from instrumentation dam, numerical analysis by finite element software PLAXIS, has been made. Plaxis results of the investigation and follow-up of the company, there is a strong and powerful application that many geotechnical engineering around the world can use it [8]. Analysis, using behavioral models Mohr-Coulomb, is done. On the other hand, we can say that, numerical methods, the analytical methods is very rapid, reliable and accurate, and therefore these methods, able to perform parametric studies, the boundary conditions are complex. In this study, the phenomenon of arching, narrow barrier bathrooms, is studied.

The extent of benefits including cases kinematics (kinematic), and stability theory of plasticity, to obtain amplitude changes, the correct solution to the problem of stability reduces in practice. This can range finding possible solutions greatest lower bound, upper bound solution to the lowest limit. Unknown quantities, may be bearing capacity of the foundation, earth pressure on retaining wall, slope safety factor or the height of the crisis, and so forth. In the analysis of air, soil deformation plasticity in accordance with the law of normality, used, in terms of the surrender Coulomb, is assumed. It's static stress field, considers that, on the balance of forces, and the volume, and yield criterion does not violate any part of the soil mass (acceptable for static stress field). The use of static case, leading to a set of differential equations (differential) which, numerically using the finite element method, solved [1 and 2].

Findings

As is clear from Figure 2, the arching of the dam height is variable, and strongly arching and the maximum arching, core thickness depends on the height of the dam. And the thin vertical cores (steepness), arching at the core of the dam, rather than vertical core widescreen (slope slower) is. The analysis shows that the parameter w / h (core width to height ratio of the core) is large, arching factor is increased accordingly arching decreases.

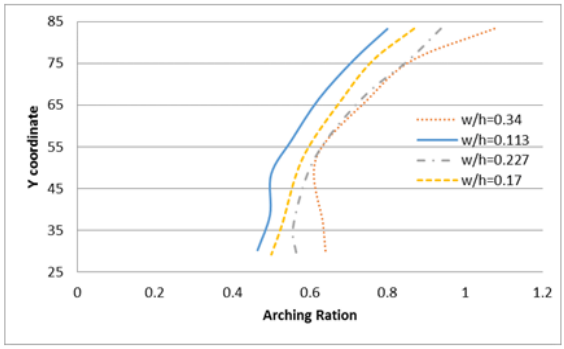

Figure 2. The effect of the core width to its height on the arching in core vertical.

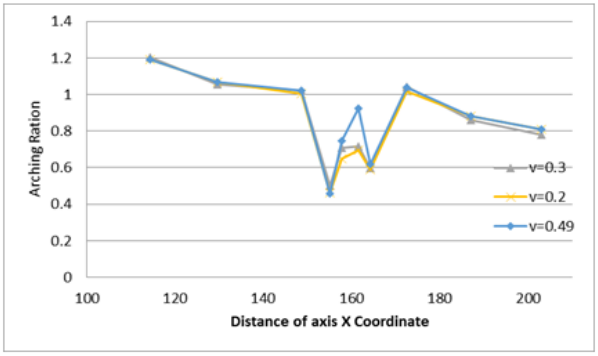

Figure 3. The effect of clay core Poisson's ratio changes on the arching Ratio.

Therefore, due to the overlapping parts of the shell, the distance from the axis along the x's, are more sensitive between 150 to 170 meters, limited to the shape, size, and discuss the results will be better.

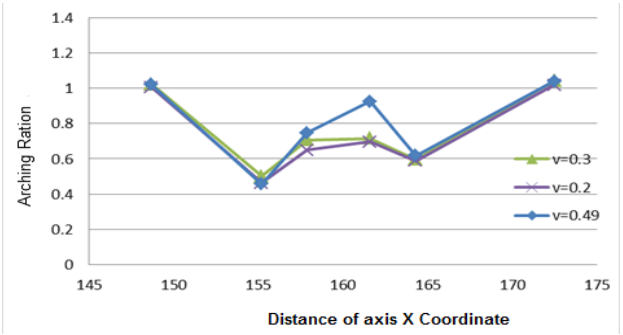

Figure 4. The effect of clay core Poisson's ratio changes on the arching Ratio.

Considering the above, we can see that by increasing the clay core Poisson's ratio, the ratio of arching, ranging from core increases, and outside of the core, are associated with subtle changes.

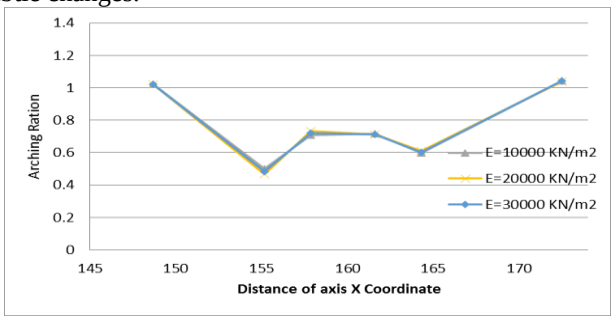

Figure 5. The effect of clay core modulus of elasticity changes, the over arching.

As the figure above shows, a 3-fold increase modulus of elasticity clay core, dam to, the arching, has made little changes.

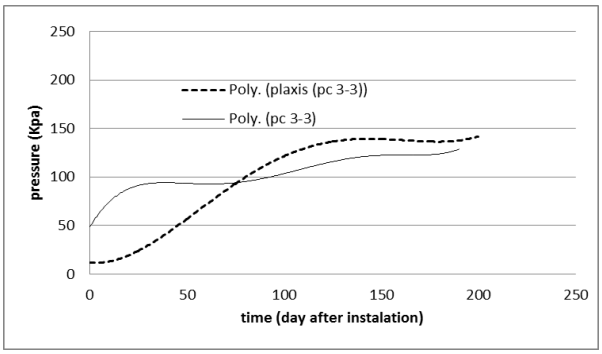

Figure 6.Comparison of tool pc-3-3 result and software results.

From Figure 6 it can be concluded that: build layers of instruments and gauges with software results some difference, but over time the results of instrument gauges, the results of the application Plksys closer, but in general, the results of the application plaxis, consistency with the results of the instrument.

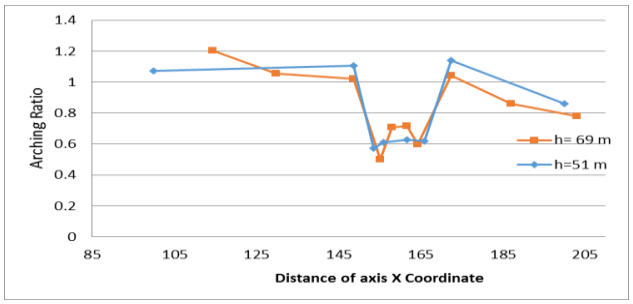

Figure 7.Study of arching in vertical core in at different heights tange hamam dam.

As Figure 7 indicates, at the level of entering the clay core, significantly, the arching decreases, which indicates that the possibility of arching in the area, will, and must be considered arching factor, no matter how high the risk is less arching.

The barrier materials, poor filter selection between the core and the shell, can be the most possible solution is to reduce shrinkage arc.

Also, the barrier to, you should use the results of the utility meter installed in the dam, as shown in Figure 8 and the output of the normal stress used, and based on the ratio of the stress on the phenomenon vault removing reviewed.

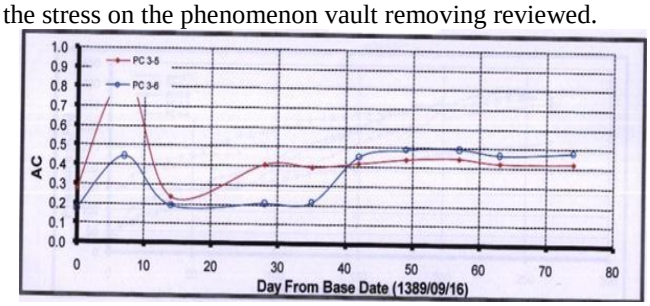

Figure 8.The arching coefficient variation curve, over time for the total pressure cells PC3-5 and PC3-6 [9].

The arching convergence rate, pressure cells, 3-5 PC- V3-6, PC- equal to 0/42 and 0/48, which, at this stage, the tension at the point of pressure cell, by application review it is, then arching factor is obtained. This amount is calculated by the software is:

0.530=$\frac{409.92}{36.1*21.4}$ =Arching factor= $\frac{\sigma_v}{\gamma.h}$ = Arching factor 3-5 PC.

0.550=$\frac{410.13}{35*21.4}$ =Arching factor= $\frac{\sigma_v}{\gamma.h}$ = Arching factor 3-6 PC.

The pressure cells, arching factor, pressure cells V3-6 3-5 PC- PC-, 0/42 and 0/48 respectively, and the amount obtained from the output of software, 0/53 and 0/55 respectively, which, at around 0/12 gauge tool is more results, but both of these values are within the acceptable range. Due to the high impact of the consolidation, the arc intensity drops, the speed of construction should be chosen in such a way that, prior to the implementation of the upper layers, part of the consolidation of the substrate, is performed.

Conclusion

Safety and performance of a dam to dam construction in different stages, to be controlled. In this study, arching phenomenon, in Dam Tang-e Hamam, the finite element method, is studied

The arching, the barrier height is variable, and strongly arching and the maximum arching, core thickness depends on the height of the dam. And the thin vertical cores (steepness), arching at the core of the dam, rather than vertical core widescreen (slope slower), is. The analysis also shows that, the parameter w / h (core width to height ratio of the core) is large, arching factor is increased, and accordingly arching decreases.

At different levels, with the arrival of the clay core, significantly, the arching decreases, which indicates that the risk of arching in the area increases.

In the pressure cells, arching factor Amount in pressure cells V3-6 3-5 PC- PC-, 0/42 and 0/48 respectively, and the amount obtained from the output of software, 0/53 and 0/55 respectively, which, at around 0/12, gauge tool is more results, but both of these values are within the acceptable range.

References

1. Yu HS, Salgado R,Sloan SW, Kim JM. Limit analysis versus limit equilibrium for slope stability. Journal of Geotechnical and Geoenvironmental Engineering, ASCE 1998;124(1):1-11.
2. Lysmer J. Limit analysis of pkane priblems in soil mechanics. Journal of soil Mechanics and Foundation Division, ASCE 1970;96(SM4):1131-334.
3. Chen WF. Limit analysis and soil plasticity. Amsterdam (the Netherlands): Elsevier Science, 1975.
4. Michalowski RL. Three dimensional analysis of locally loaded slopes. Geotechnique 1989;39(1):27-38.
5. Mohammad-Hosseiny S.M. and Ahmadi-Fard R.2005. pore pressure development in the core of earth dams during simultaneous construction and impounding. Electronic Journal of Geotechnical Engineering.
6. Bundle A "earth dams precise instrument ". Engineering co of Sepah Sad 2012.
7. Nikkhah, M.; Attaie, S.; Tavakoli, H. and Hasan, Y., "Evaluation of Instrumentation Records of the Dam Body and Foundation if Embankment Mollasadra Dam during Construction and First Stage impounding", ICOLD 75th Annual Meeting, Saint Petersburg, Russia, June 24-29, 2007.
8. Plaxis 2D (2009), "Reference Manual", Plaxis BV, Amsterdam, The Netherlands.
9. Report of tange hamam dam Monitoring, Engineers co of Moshaver Abfan, March 2010.