Journal of Civil Engineering and Urbanism

Volume 4, Issue 5: 550-553 (2014) ISSN-2252-0430

Zoning of Flood Caused by Farrokhi Dam Breaking of Qaen South Khorasan, Iran

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ABSTRACT: Due to the very high losses caused by breakage of dams, especially with regard to the dams that are constructed in the upstream of population centers, dam breakage of studies, including estimating fracture parameters, routing, and flood zoning caused by dam breaking for safety management at downstream dams, seem to be necessary. This is possible with the use of hydraulic models and GIS. In this study, using a dam breaking analysis for Farrokhi dam of Qaen located in South Khorasan, and use computer models HEC-RAS, GIS and Breach, flood zoning of the case is investigated. According to the results of failure analysis, flood routing, is performed downstream of dam above, and the result is entered in GIS, and flood zone is provided. Based on the results from rural areas of Farrokhi and Mahdiabad, downstream of the dam is exposed to the risk of dam break flood. Furthermore, it is suggested, using a risk matrix, areas at risk from flooding, to determine, by combining maps, speed, and depth of flooding, and determine the amount of risk in each area of high risk areas. Forecasting losses reduction system such as flood warning systems, anti-flood out buildings, editing recipes measures in emergencies, dams, public procurement procedures, to deal with emergencies, and perform periodic maneuvers to necessary to maintain readiness for dealing with crisis situations, the separation of risk areas is essential.

Keywords: Dam Break, Flood Zoning, Farrokhi, HEC-RAS

ORIGINAL ARTICLE
Received 14 Jul. 2014
Accepted 13 Aug. 2014

INTRODUCTION

One of the critical issues in the maintenance and operation of dams is failure the dam. Flood caused by dam break, causing a lot of damage and losses. Dam break and the resulting output current, is considered one of the most important research studies in many countries and research institutions, and is currently ongoing. This phenomenon can occur due to various reasons, such as overflow of water from the dam (Overtopping), failing spillway discharge capacity, leakage, creating the phenomenon of pipe in the dam (Piping), earthquake, creating a shock wave a (Impulse wave), the effect of the sliding mass entry into the tank, or the intentional incidents (sabotage and terrorist attacks) (America's Army Engineering Department, 1998). Failure the dam, water level changes, downstream of dam, the flood wave caused by the sinking of urban and residential areas around the river, which leads to damage many. Available data shows, the greatest failure is related to the earth dam, which, however, is relatively large, the operation of dams.

Due to the very high losses caused by dam break, particularly in relation to dams that are constructed in the vicinity of large cities, it is necessary that this phenomenon is also considered at the same time, the study and design of various parts dam. For this purpose, it should be specified output hydrograph caused by dam break, the type of failure is doing different things, to predict the maximum flow output. Flood routing, resulting from dam break, mainly fall into the following four categories:

Physical or mathematical methods, including the will, predictions of failure, and outflows resulting from failure, which have been established, erosion models are based on the laws of hydraulics, sediment transport, and soil mechanics, among which are can be cited, such as model to model SMPDBK (1984), model BREACH (1985), BEED model and so on. Figure 1 shows the output from a 3D numerical model.

Parametric models: in this context, is the use of examples, the information is available, the calculated failure time, and the final geometry failure, and then failure and output current development failures, are simulated using rules hydraulics, among which we can mention the work that has been done by Chanson H (2005), Hervouet (2000).

Malat predictors: peak flow, empirical equations, which are established based on sample survey data, has been calculated and is also assumed to have a reasonable output of the hydrograph. A comparative analysis: the dam, which is being examined, it is like a broken dam, the size, structure, and is available, it is true, you can set failure parameters and the peak flow, the by comparison.

After obtaining the output rate, according to the morphology downstream of the dam, flood routing process, it becomes clear, and the area of dam break is determined. This is achieved by using a combination of hydraulic models and GIS. These maps can have these criteria for making administrative decisions, in determining damages caused by dam break.

To cite this paper:Rezaei M., Rezvani Mahmuee A., Khaksefidi S. 2014.Zoning of Flood Caused by Farrokhi Dam Breaking Of Qaen South Khorasan, Iran. *J. Civil Eng. Urban.*,4 (5): 550-553.
Journal homepage http://www.ojceu.ir/main/

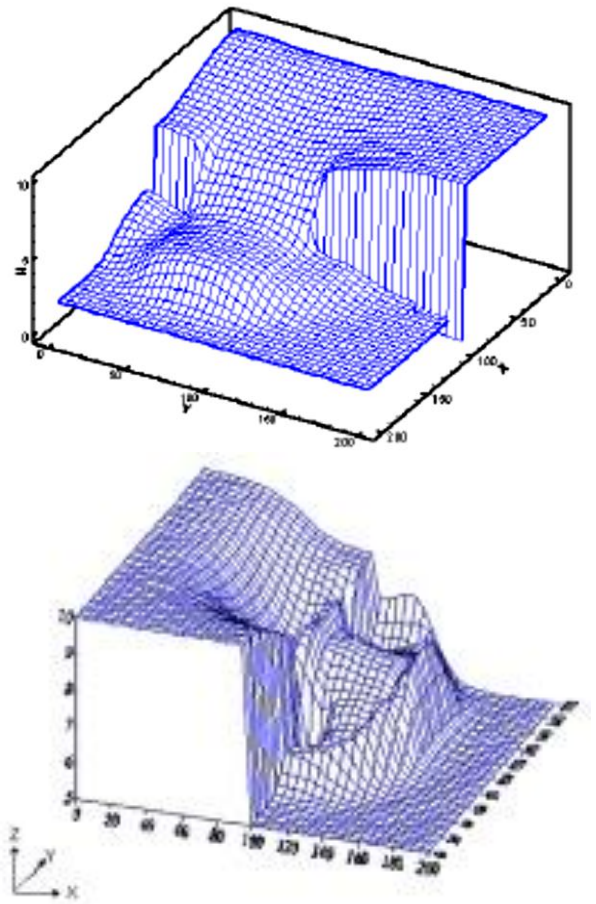


Figure 1. An example of the output of three-dimensional models, dam break

MATERIAL AND METHODS

Flow that is caused by a failure of the dam is a non-permanent flow; the time has a major role in the specification changes. In other words, the non-permanent fast variable, creates a wave flow, the dam, the water surface profile curvature, is it fast. Changes in flow depth, towards time are fast, the vertical component of the acceleration of the water particles, relative to the total momentum is significant.

Failure dam (dam Break), including issues that could be examined, analysis of positive and negative wave. Simplest case, for this purpose, when the slope of the substrate resistance is negligible, and the rectangular channel, it is assumed that, in this case, similar to the situation that a valve in a vertical channel, and the upstream of it, there is a living body of water. All these models are based on the flow field, and do not enter, due to coastal erosion and sediment transport in the equations. Hydraulic failure dam is like a sudden release of water from a reservoir. In this case, the formation is a progressive wave of negative and positive, analytically, at the height of the valve, and can be obtained, the equivalent flow rate, formulas 1 and 2.

(1) $y_{x=0} = \frac{4}{9} y$

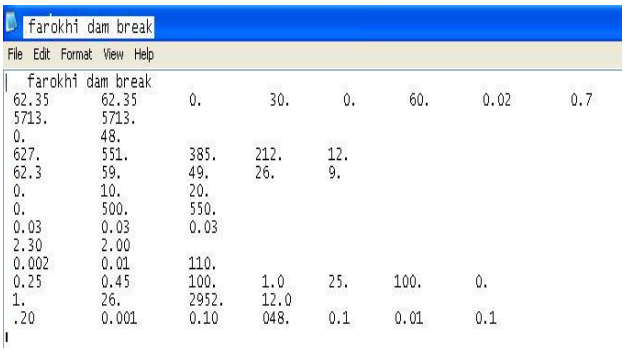
(2) $V_{x=0} = \frac{-2}{3} \sqrt{g y_0}$

In this study, using a dam breaking analysis for Farrokhi dam of Qaen located in South Khorasan, and use computer models HEC-RAS, GIS and Breach, flood zoning of the case is investigated.

Figure 2. Qaen City and Farrokhi Dam location

In this project, due to the mechanical properties and dynamic, the dam embankment, at first, the openings created by the phenomenon of dam break, the body of the dam has been modelled according to the ability of the model BREACH. Numerical simulation model BREACH, is a one-dimensional numerical model, the basic version of this model, published in 1988 by the center for Meteorology in America. The rate is calculated by the software zoning, the numerical model HEC-RAS.

To simulate the application environment BREACK, need to be invoked, all the data stored in a text file, and the application environment. Figure 3 shows a portion of the input file in the application environment.


farokhi dam break

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 farokhi dam break
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0.25      0.45      100.    1.0     25.    100.    0.
1.        26.       2952.   12.0
.20       0.001     0.10    048.    0.1    0.01    0.1
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Figure 3. The input file to the application environment

After calling this file, software, software starts, calculations, and provides the results of the model, the output hydrograph resulting from a failure.

According to the results of failure analysis, flood routing, is performed downstream of dam above, and the result is entered in GIS, and flood zone is provided.

RESULTS AND DISCUSSION

As explained above, after calling this file, software, software starts, calculations, and provides the results of the model, the output hydrograph resulting from a failure. Figure 4 shows the hydrograph output from the model.

As is clear from this figure, the maximum discharge established at the time of 58 minutes, after the failure of the dam is equal to, 3077.9 cubic meters per second. The floods, caused by the failure dam, which subsided after 5.9 hours, are equal to the rate of input to the river upstream of the reservoir.

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Then, the discharge caused by dam break model is Software Environment HEC-RAS. To obtain the rate of Discharge distribution created. Figure 5 shows a cross section created in the software environment HEC-RAS.

Zoning was created with the water level on the desired result may be due to area flooding downstream. The study area is shown in Figure 6. These results indicate that, villages and Ebrahimabad-Farrokhi way Qaen-Esfedan, will be at risk if dam break.

Figure 6, the green line shows the zone due to the failure of the dam, at a distance of up to 2 hours after dam break, and the purple line shows the zone due to failure dam, between 2 and 6 hours after the dam break.

According to the results, rural areas of Farrokhi and Mahdiabad, downstream of the dam is exposed to the risk of dam break flood.

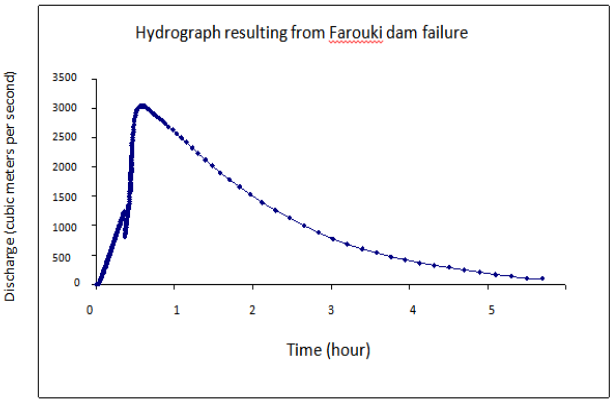

Figure 4. Hydrograph resulting from a dam break Farrokhi Qaen

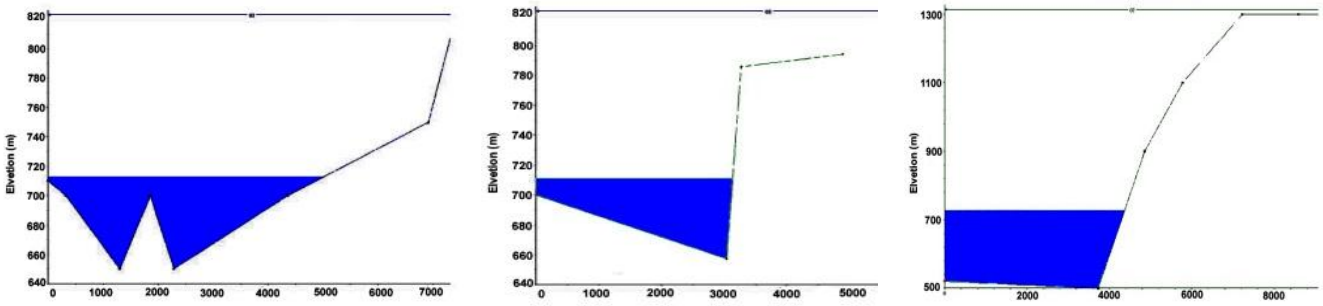

Figure 5. Sections created in HEC-RAS

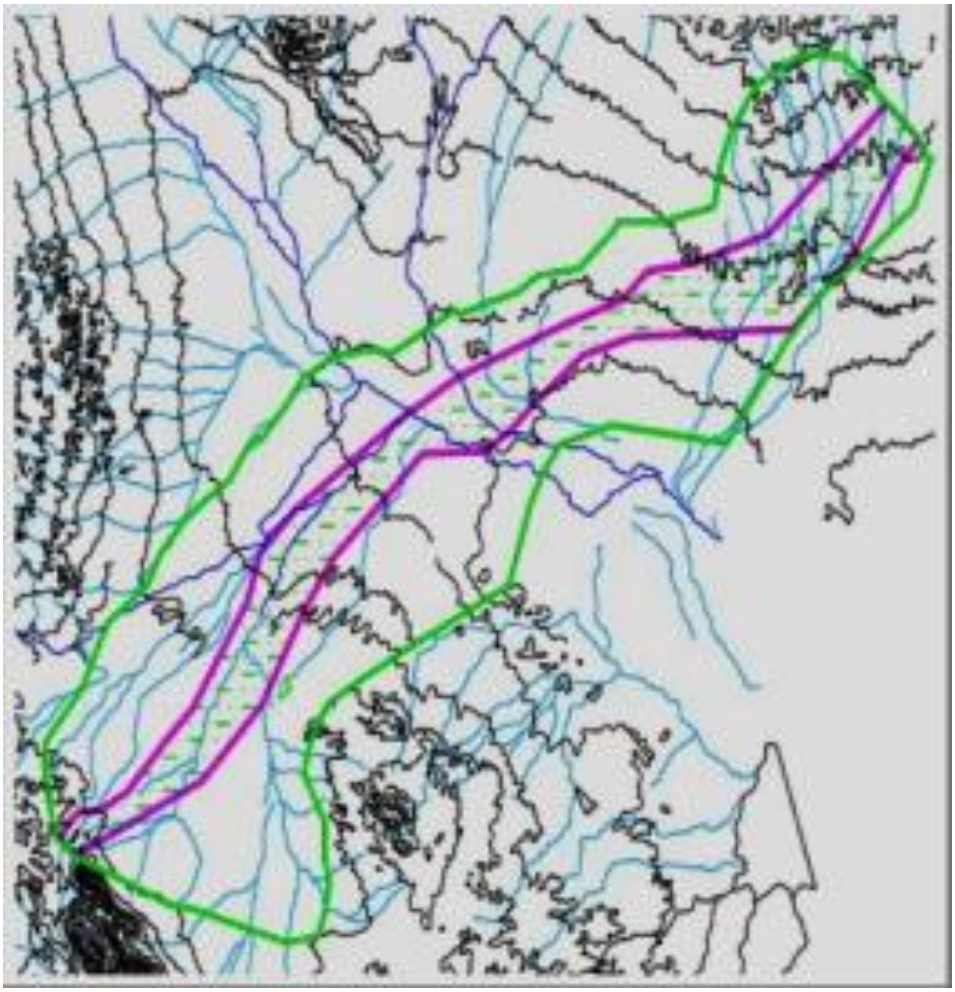

Figure 6. Flood zoning, break of dam

CONCLUSIONS

High Discharge created, is, at 58 minutes after dam break, and equal to 3077.9 cubic meters per second. The floods, caused by the failure dam, which subsided after 5.9 hours, are equal to the rate of input to the river upstream of the reservoir.

Results of flood zoning, shows that villages and Ebrahimabad-Farrokhi way Qaen-Esfedan, they will be threatened in the event of dam break.

Furthermore, it is suggested, using a matrix can be known hazard areas at risk of flooding, by combining maps, speed, and depth of flooding, and determine the amount of risk in each area of high risk areas , and forecasts, and reduce system losses, such as flood warning systems, anti-flood or out buildings, editing recipes measures in emergency situations, the dams are required to prepare general guidelines for dealing with emergencies and maneuvers periodically to maintain readiness necessary to deal with crisis situations, a separate risk areas.

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