2011 2nd International Conference on Environmental Engineering and Applications
IPCBEE vol.17 (2011) © (2011) IACSIT Press, Singapore

Dam-break flood plain model by WMS

Mahdi Moharrampour [1+], Amin Khodabandeshahraki [2] and Mahya Katuzi [3]

[1] Young researchers club Islamic Azad University, buinzahra Branch, buinzahra, Iran
[2] Department of Civil Engineering, Islamic Azad University, buinzahra Branch, buinzahra, Iran
[3] Department of Electricity Engineering, Islamic Azad University, Qazvin Branch, Iran

Abstract. Realizing the heavy contents of water is caused by barrier breakage that it can make enormous waves in shoal. When it's breaking, we would have such big financial damages certainty but criminal damages depends on several different factors such as the wreck region, the population who live in that region and the alarm time before the breakage. So one of the most important factors for inventing the financial and criminal damages are, calculating the water height in river in ideal manner and the water height which was produced by flood waves movement in barrier breakage. WMS software (Latrine region reconstruction system) is so pervasive and important software for graphical models in water engineering and in all cases of hydrologic and hydraulic latrine region. WMS is so strong software for automatic reconstruction observation steps of latrine region such as automatic tightening of latrine region boundaries, calculating the physical and geometrical parameters of region, calculating and producing the overlapped layers in GIS system as same as these factors (determining the prevalence cycloid, rainfall depth, rough coefficient …). Extraction the phenomenal segments from ground numeral maps and some other different factors. One of the most useful usages of this software is Delineate Floodplain .So in this project, Using specifications Bidakan barrier and estimate dam-break parameters in this barrier that which is located in the center of Iran, breaking the Bidakan barrier was simulated with WMS and the divided region's flood of this breakage around 15 kilometers of it was presented by using of geographical information system (GIS) and WMS software. Finally, the SMPDBK model's results were compared with DAMBRK's results and the results show that the SMPDBK model has 10 percent average errors lower than other model.

Keywords: dam-break model, WMS software, flood plain, GIS, embankment Bidakan

1. Introduction

Welcome Terrestrial barriers are one of the oldest structural installations that rudimentary necessary of man to agricultural base and water made them to create the terrestrial barriers. Precedence of terrestrial barriers manufacturing in different shapes and dimensions is related to far history. Manufacturing the terrestrial barriers encounter to widespread ovation in Iran and it's clear that the numbers of these barriers are much more than other kinds of barriers in all over of country but unfortunately the breakages of terrestrial barriers are more than other kind of barriers. Otherwise, the flood of the barrier breakage encounters to several different constructions around it and there are financial damages certainly so the flood of the barrier breakage will be studied and examined exactly. Water height calculation in river and the water height of the waves that are produced from flood wave's movements are so important. The Watershed Modeling System (WMS) is a comprehensive graphical modeling environment for all phases of watershed hydrology and hydraulics. WMS includes powerful tools to automate modeling process such as automated basin delineation, geometric parameter calculation; GIS overlay computations (CN, rainfall depth, roughness coefficient, etc), cross-section extraction from terrain data and many more.

[+] Corresponding author. Tel.: + 982824223562; fax: +982824225316.
E-mail address: m62.mahdi@yahoo.com

One of the most important applications of this software is for flood sheet. Simulation of terrestrial barrier breakage and flood maps of Bidakan terrestrial barrier were presented by using WMS software and SMPDBK model.

2. The studied area

Bidakan storage barrier is terrestrial kind with a clay core, 40 meter height (37 meter water height) that is generated on sir dare river and it's located on 41 kilometers west of Haruni village and it's so near to Amir Abad village. The average yearly Discharge of the river in barrier is about 0.619 m3/s that it's estimated to 19.52 m3 yearly. Bidakan barrier storage has 8.47 million m3 volumes in normal level (2552 meter) and river foam level in barrier area is 2515 meter and the barrier crown level is 2555 meter. Bidakan terrestrial barrier is shown in fig (1).

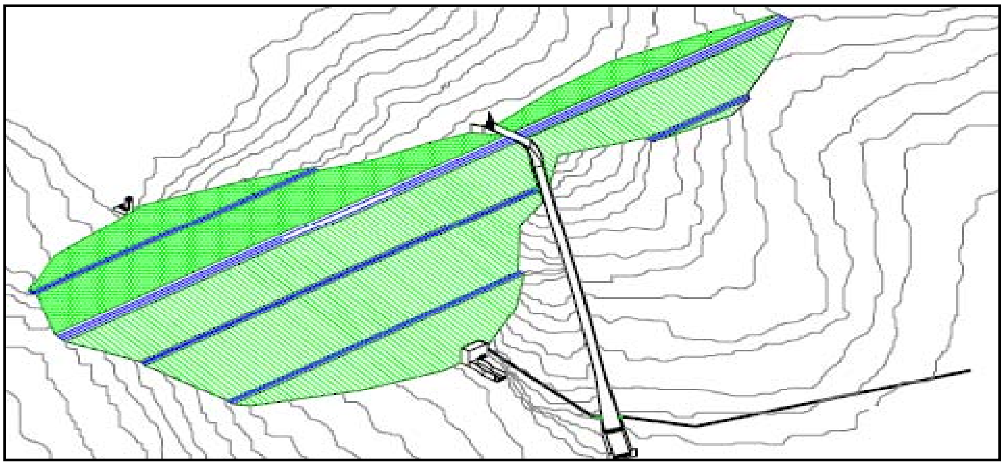

Fig. 1: Bidakan terrestrial barrier

3. Barrier breakage simulation by using WMS software and SMPDBK model

First, dam-break parameters of Bidakan terrestrial barrier for using in SMPDBK model and WMS software were estimated them then, they were modeled.

3.1. Estimating the breakage parameters

The parameters were estimated by using different equations and Bidakan terrestrial barrier data. The results are shown in tables (1) t0 (4).

Table1: Estimating the average width of Bidakan terrestrial barrier breakage

Average breakage width(meter)	The equation of estimated breakage width
120	USBR(1999)
142/7	Vantan and Gilt
89/2	Ferolich(1995)

Table2: Estimating the breakage time of the Bidakan terrestrial barrier

Breakage time (hour)	Estimated equation
1.32	USBR(1999)
0.6-1.05	Vantan and Gilt
0.48	Ferolich(1995)

Table 3: Estimating the slope of the Bidakan terrestrial barrier breakage

Breakage slope (horizontal to vertical)	Estimated equation
1	Vantan and Gilt
1.4	Ferolich(1995)

Table4: Estimating the maximum removal Discharge from Bidakan terrestrial barrier breakage

Maximum removal Discharge (m3/s)	Estimated equation
13073	Kirkpatrik
15273	SCS
10945	Hagen
17573	Reclamation
14289	Sing and esnorason
12419	makdonald and Langoich menopolice
11132	Kosta
3746	Ivance
6889	Ferolich

3.2. SMPDBK model

The simplified Dam-Break (SMPDBK) was developed by the National Wealth service (NWS) for predicting downstream flooding produced by a dam failure. This program is still capable if producing the information necessary to estimate flooded areas resulting from dam- break flood waters while substantial reducing the amount of time, data and experts required to run a simulation of the more sophisticated unsteady NWS DAMBRK or now called FLDWAV. Otherwise the more barrier breakage models such as SMPDBK and DAMBRK are presenting only the maximum removal circuits. The process of the Bidakan barrier breakage was presented by using the estimated breakage parameters and cross-sections around 15 kilometers of the barrier and SMPDBK model and WMS software. Entrance variables of SMPDBK model, SMPDBK's results, WMS software and the flood map of the Bidakan barrier breakage are presented in table (5), (6) and fig(6) respectively.

Table 5: Entrance variables of SMPDBK model

Scale	Value	Entrance variables
Meter	2555	Barrier crown level
Meter	2515	Foam final level (breakage)
Million cubic meters	10/27	Storage volume
Square meter		Reservoir area
Meter	89/2	Breakage final width
Minute	29	Necessary time for breakage
(m3/s)	111/5	flow The turbines and spillway

Table6: SMPDBK model and WMS software results at the down of the Bidekan terrestrial barrier

Maximum flood time (Hour)	Maximum flood level (meter)	Maximum circuit (m3/s)	Distance from barrier (Kmeters)
8/43	2523/83	13071	0/00
10/60	2510/59	12940	0/58
11/00	2491/00	12678	2/33
9/77	2467/11	12551	2/95
10/20	2449/71	12426	3/49
10/23	2449/71	12301	4/28
12/04	2447/73	12178	4/91
12/76	2412/75	11377	7/92
12/42	2393/09	11272	8/63
17/86	2376/04	11073	9/67
9/91	2218/13	10853	12/10
9/99	2156/78	10744	12/89
10/28	2113/43	10637	13/71
9/35	2089/89	10530	14/23

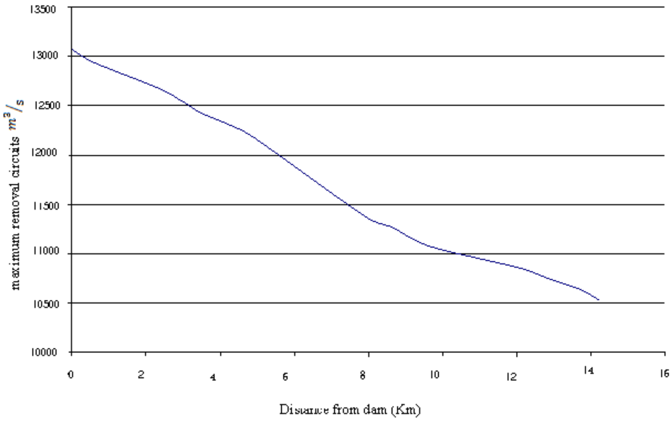

Fig. 2: Changing the maximum removal circuits at the down of the Bidakan barrier

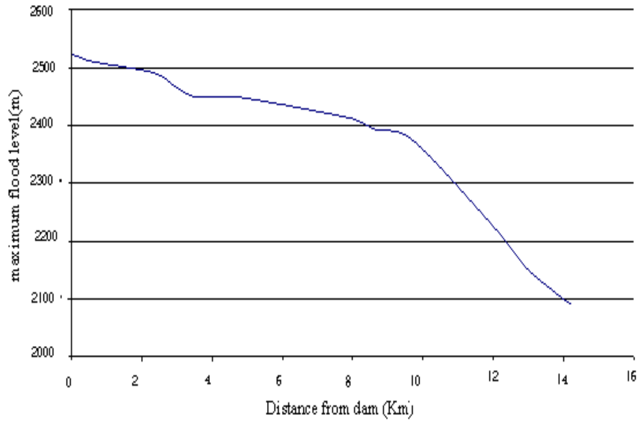

Fig. 3: Changing the maximum flood level at the down of the Bidakan barrier

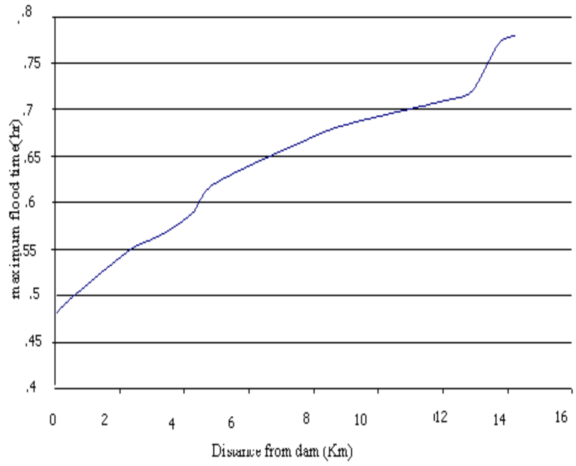

Fig. 4: Changing the maximum flood time at the down of the Bidakan barrier

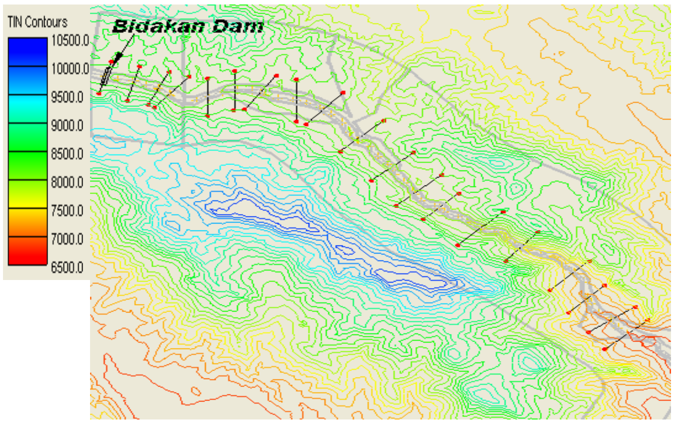

Fig. 5: Topographic lines and cross-section at the down of the Bidakan barrier before operating the model.

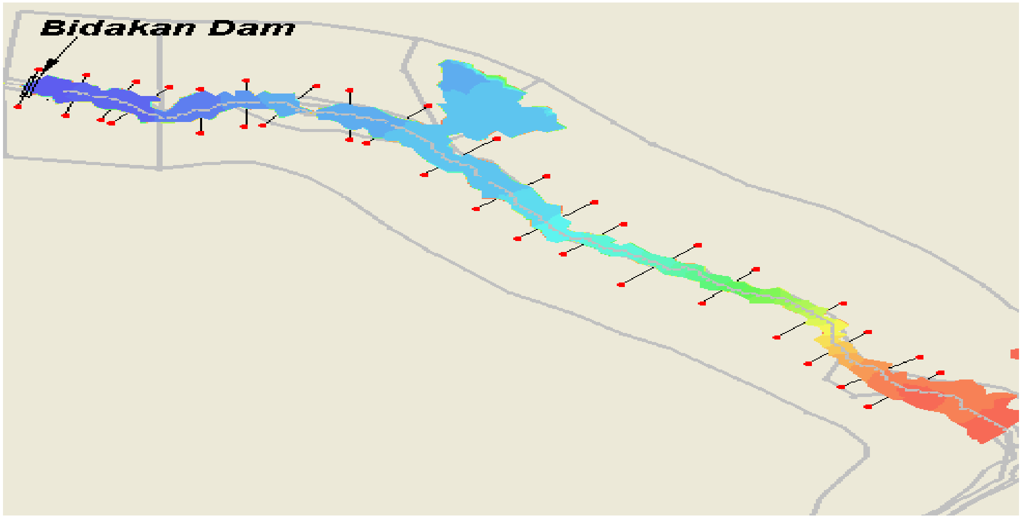

Fig. 6: The flood map of breakage at the down of the Bidakan barrier.

4. conclusion

- In the recent study and project that have done about this subject, the distance from start time and break time isn't determined exactly so, alarm time can't be determined exactly.
- Unfortunately in recent projects, there isn't any subject about the start time of breakage, whereas, start time of breakage is so important and necessary for determining the financial and criminal damages.
- Qualm analysis has to be done for predicted equation of breakage parameters and removal circuits. There's such a big qualm for prediction of breaking width, breaking time and maximum removal circuits. equations of breakage width, breakage time and maximum removal circuit. Therefore it's so benefit to recognize the qualm scale and it's operation on predicted methods parameters and studying about barrier breakage danger.
- Qualm is calculated for several parameters: breakage width: ±1/3 equal to the observed value, for breakage time: ±1 equal to real value.
- Qualm analysis results show that breakage time and width of Bidakan terrestrial barrier that were calculated with Ferolich method are 89.2 meter and 29 minute respectively.
- Barrier disconnection "Buffalo Creek", average error of SMPDBK model were predicted in maximum circuits so the transferring time was 10-20 percent and level error of maximum flood was 1 foot.
- SMPDBK was compared with DAMBRK model; the results show that SMPDBK has average error 10 percent lower than other model.
- SMPDBK model is so benefit not only in emergency barrier breakage but also for calculating the level of probable flood and transfer time before barrier disconnection.
- In long time project for preparing against a big catastrophe with enough equipment such as a good computer for estimating the level of probable flood and the time of the maximum flood, DAMBRK model is more reliable, but in short time project with narrow equipments and sources SMPDBK are more reliable for determining the level of maximum flood, Discharche and transfer time.
- SMPDBK is so benefit and good model for preparing during the barrier disconnection but it has so limitation, first prediction precision of SMPDBK model is related exactly to arrival necessary data precision. (Maximum Data are made by operator) so operators have to prepare the best data whereas this model is guessed in normal state so several different parameters such as barrier base failures or other failures around it, aren't considered, so in this condition the maximum flood isn't estimated properly and other models have to be used.
- Maximum removal circuits from Bidakan barrier by using SMPDBK model is 13071 m3/s.
- Procedure of Bidakan barrier maximum removal circuit shows that maximum removal circuit is in the barrier region.

5. References

[1] Hasanzadeh, Y, barrier breakage hydraulic, *first edition,Tehran, big barrier national committee*.

[2] Rahimi, H.Terrestrial barrier, 1382, first edition, *Tehran, Tehran university*.

[3] Vicher,DL and Heger, Vach, Barrier hydraulic, 1382, *Translated by Masoud Ghodsian, Tarbiat Modarres university.*

[4] *Consultant engineer of Maharab Omran gostar, Bidekan terrestrial barrier report, 1383*.

[5] Brown, C.A., and W.J. Graham, *Assessing the Threat to Life from Dam Failure, Water Resources Bulletin, vol. 24, no. 6, December, 1988.*

[6] Costa, John E, Floods from Dam Failures, U.S. *Geological Survey Open-File Report 85-560, Denver, Colorado, 1985*

[7] Engineers and Scientists, 2nd ed., Harrison M. Wadsworth, Jr., editor. McGraw-Hill, New York, NY,
Goubet , A, Risqes Associees aux Barrages*, La Houille Blacche, No. 8, (1979)*

[8] ICOLD/CIGB, Dambreak Flood Anaysis, Review and recommendation, (1995).

[9] Rogers, J. David, and David J. McMahon, Reassessment of the St. Francis Dam Failure, Dam Safety , 10th Annual ASDSO Conference, Kansas City, Missouri, September 26-29, 1993.

[10] 12. Singh, V.P., 1996. Dam breach modeling technology. Kluwer, Dordrecht, the Netherlands.

[11] WAHL, TONY L, Predicting Embankment Dam Breach Parameters - A Needs Assessment", U. S. Bureau of Reclamation, Denver, Colorado, USA, 1998.

[12] Wetmore, J, Fread, D, THE NWS SIMPLIFIED DAM-BREAK FLOOD FORECASTING MODEL, *The National Weather Service (NWS), 1991.*

[13] Wurbs, R. A., , Dam-Breach Flood Wave Models, *Journal of Hydraulic Engineering, Vol. 113, No. 1, 1987*

[14] Zhu, Y., Visser, P.J. and Vrijling, J.K, Review on embankment modeling. In*: Wieland, M., Ren, Q. and Tan, J.S.Y. (Eds), New Developments Dam Engineering, Taylor & Francis Group, London, UK, 2004b.*

[15] *Yonghui, Breach Growth in Clay-Dikes, Hohai University, China , 2006*