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The study of flood hydraulics before the building of Maroon Dam by HEC-RAS, Maskingam and Muskingum - Cunge method

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Abstract

Routing of rivers which flow through the important areas is from the important river engineering measures. In this research, flood routing in the Maroon River has been studied bases on hydrometric stations between Behbahan and Chamnezam. Todays, numerical computer methods are developed for the Cent and Nante equations. The HEC-RAS software and Muskingum and Muskingum - corners methods are used for this work. HEC-RAS model with solving of dynamic equations motion simulates unsteady flow in the form of onedimensional flow in open channels. After calibration and testing, the results of these methods were compared.So, the HEC-RAS model results considerably better match with the observational data.

Keywords

maskingam, method, study, flood, hydraulics, cunge, before, muskingum, bulding, maroon, dam, hec, ras

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The study of Flood Hydraulics before the Bulding of Maroon Dam by HEC-RAS, Maskingam and Muskingum - Cunge Method

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ABSTRACT

Routing of rivers which flow through the important areas is from the important river engineering measures. In this research, flood routing in the Maroon River has been studied bases on hydrometric stations between Behbahan and Chamnezam. Todays, numerical computer methods are developed for the Cent and Nante equations. The HEC-RAS software and Muskingum and Muskingum - corners methods are used for this work. HEC-RAS model with solving of dynamic equations motion simulates unsteady flow in the form of one-dimensional flow in open channels. After calibration and testing, the results of these methods were compared.So, the HEC-RAS model results considerably better match with the observational data.

Key words: Floods; HEC-RAS; Muskingum; Muskingum - Cunge; Routing.

Introduction

Water demand associated with population growth and the development of urban civilization is constantly increasing. So that the consumption of water from initial population to developed countries increased from a few liters per day to several hundred liters per day. Human used not only directly from water but also has made profits from it in energy production, transportation, therapy (hydrotherapy), Industrial, agricultural, recreational and in the near future, most of the political world will be affected by the water. Our country with its special status has the arid and semi-arid climate such that the mean annual precipitation is about 250 mm and its rainfall is a quarter of average raining of world. Therefore, the water has extremely important role in Iran and will have a more important role in future with the population increase and programs development. Any plan of development and restoration is incomplete without water studies. In addition to the great rivers, there are sufficient water for municipal, industrial and irrigation purposes. Therefore, a large part of advances of urban developed centers, industrial and agricultural is located along the rivers. But gigantic flood in the river was considered a threat to the facility constructed adjacent. However, an important part of rivers flood has controlled, but it still damaged to the human communities and resources. To prevent flood damages, we should estimate the probability of floods and using appropriate methods and specific facilities to control the flood impacts. For example, can be named from the construction of reservoirs, embankment, flood and prudential measures and reform of the rivers.

In all these cases, the predicted of water level and flood wave movement is very important in critical areas of the river. In addition, the impact of reservoir dams on reduce of flood flows should be determined. Expected of flood elevation changes in the reservoirs and rivers is done by routing. Also, we can estimated the impact of reservoir dams in terms of passing flood volume and identified the type of preventive action according to importance of facilities in downstream [1]. The study of flood is doing by hydrologic and hydraulic ways. In hydraulics routing used from continuity equation and movement equation and it is based on the non-permanent streams theory. This type of routing is accurate but solving its equations is difficult that we must use from the computer and extensive information needs.

The hydrologic method is not so accurate but it is much simpler and in the design of structures and flood control is used with acceptable confidence. In hydrologic method fundamentals are movement continuity equation, natural hydrographs and the maximum flood level. Movement of the flood wave divided in two parts: motion of the wave into the

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reservoir and the river path, and in any case, the hydraulic method is used. When the water returns to the river and it is very steep or low slope, the significant dynamic effects are important; in such situations hydraulic routing is better than hydrological routing [2].

Materials and Methods

In this research, flood routing in Maroon Rivers has been done by using two software, HEC-RAS and MIKE11 models. The interval station is between the Behbahan and Chamnezam hydrometric stations. HEC-RAS model is used from the four-point implicit finite difference method. Each model for simulation and unsteady equations requires boundary conditions and initial in the flow upstream and to draw water surface profile is required a boundary condition at the downstream. Boundary conditions used in the upstream is flow hydrograph at Behbahan station that changes with every flood statistics. In the downstream direction is used from Debi - Eshel relation as a boundary condition [3]. Statistic data of Behbahan stations from 1952 and Chamnezam station from 1977 are now available. But because from 1997 the Maroon Dam in the upstream of Behbahan stations is in orbit, flood routing were studied in years before 1997 and after 1952 because the outflow of Maroon Dam is a regulation flow and not appropriate for routing. Roughness coefficient estimated in this range is 0/02. After using flood routing by HEC-RAS method and obtain the output hydrograph for various flood and compared the results with the observed outflow hydrograph, calculation must be done by Muskingum and Muskingum - Cunge methods [4]. Calculation of Muskingum and Muskingum - Cunge methods are done by MIKE11 software. In Muskingum method by MIKE11, for χ, K coefficients is used from the results calculated by the least square method. By entering the Roughness coefficient and input hydrograph in the upstream and Debi - Eshel relation in the downstream can be used MIKE11 software separately for Muskingum and Muskingum - Cunge methods.

-Calibration and testing models:

Roughness coefficient estimated in the range Behbahan to Chamnezam is n=0.02 and because the limited information about the junctures roughness coefficient, in all the way was used a constant roughness coefficient. For calibrate models are needed to be available the flood observational data at upstream and downstream. With compare the model results with observational data, estimated roughness coefficient is modified and for this purpose is used from the boundary condition of the flow hydrograph at the upstream. After calibration, the models should also be tested for other statistical observations and the roughness coefficient to be examined carefully. Here to be compared the output hydrographs of HEC-RAS, Muskingum and Muskingum - Cunge models. The results gained for 12 various flood. According to the similarity of the results, we study the results of flood routing in 1989 in this section. The table 1 compares the results of the routing hydrograph in the Maroon River in the range of Behbahan to Chamnezam from 1989/9/12 until 1989/9/14. This may indicate that the flow obtained from the HEC-RAS software in the Chamnezam station with outflow observations in it, is closer to reality from the results of Muskingum - Cunge and Muskingum methods. This conclusion can be sought in the correlation coefficient results. According to table 1 correlation coefficient for HEC-RAS, Muskingum and Muskingum - Cunge methods is respectively 0.95205, 0.92571 and 0.92707. With careful attention to these numbers can be known that the Muskingum - Cunge method has the second level of importance after the HEC-RAS method. we realize that the peak flow in HEC-RAS and Muskingum - Cunge method are very close together (Observed output peak flow 3609, the calculated output peak flow by HEC-RAS method 3805/96, the calculated output peak flow by Muskingum method 3427/77, the calculated output peak flow by Muskingum - Cunge method, 3834/66). These numbers determines more accuration of the HEC-RAS and Muskingum - Cunge methods compaired to Muskingum method. So in flood that is seen in 1989/9/12 until 1989/9/14, the flood routing with HEC-RAS results show good accuracy.

Table 1: Comparison of the output results from the different methods of flood routing in rivers Maroon

Start flood	End of flood				
1989/09/12	1989/09/14	R^2=0.95205		R^2=0.92571	R^2=0.92707
Time (Hour)	Inflow hydrograph (Behbahan) (m^3 / s)	observational data	HEC-RAS software	Muskingum	Muskingum - Cunge
		Out flow hydrograph (Chamnezam) (m^3 / s)	Out flow hydrograph (Chamnezam) (m^3 / s)	Out flow hydrograph (Chamnezam) (m^3 / s)	Out flow hydrograph (Chamnezam) (m^3 / s)
0	120	116	120.00	120.00	120.00
2	122	111	105.95	120.28	104.58
4	130	97	105.22	120.20	107.49
6	138	94.9	101.60	127.01	106.66
8	149	84.2	112.04	133.75	114.41
10	180	80.6	122.68	145.29	123.24
12	230	102	130.78	168.69	130.61

14	282	132	140.95	204.99	140.80
16	362	248	160.15	252.63	160.61
18	430	380	200.66	311.52	201.68
20	503	590	258.43	377.86	259.62
22	580	608	340.28	447.91	342.11
24	665	898	437.17	522.37	430.64
26	760	1228	513.50	603.22	511.36
28	870	1443	602.08	692.86	599.84
30	1040	1245	700.95	800.49	698.58
32	1338	1294	806.96	955.47	806.10
34	2300	1602	959.05	1270.45	959.18
36	3150	1898	1297.19	1876.84	1286.35
38	3800	2209	2136.47	2571.05	2157.36
40	3961	2814	3163.10	3176.42	3229.13
42	3090	3609	3805.96	3427.77	3834.66
44	2925	3394.5	3707.14	3244.63	3651.55
46	2600	3180	3118.44	3047.89	3100.28
48	2300	2830	2933.50	2793.77	2922.76
50	2020	2517	2626.17	2520.66	2587.75
52	1720	2204	2316.02	2241.51	2318.14
54	1440	1969.5	2067.13	1955.24	2065.36
56	1190	1735	1801.24	1676.11	1796.03
58	860	1403	1510.52	1399.70	1510.02
60	590	1071	1244.91	1106.19	1259.66
62	465	845.5	1002.16	843.95	1007.32
64	405	620	758.13	655.85	761.54
66	370	536.5	572.95	531.98	576.81
68	345	453	467.36	451.67	470.36
70	320	415	405.57	397.59	409.68
72	305	377	371.24	358.70	378.41

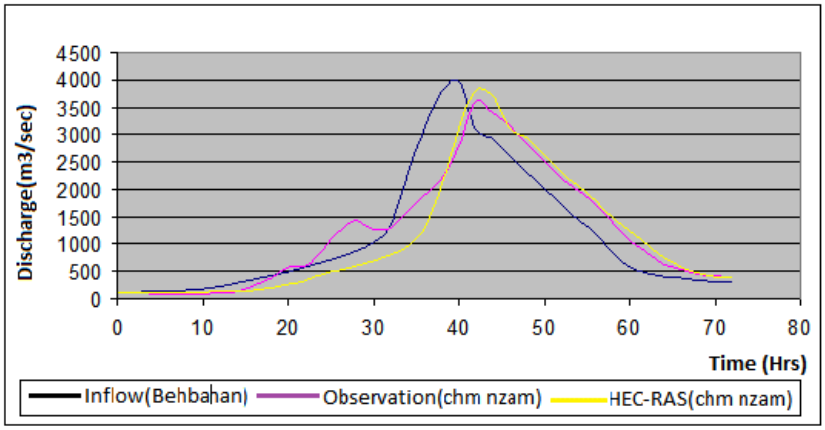

Fig. 1: Flood routing of Maroon river in the Chamnezam station by using software HEC-RAS

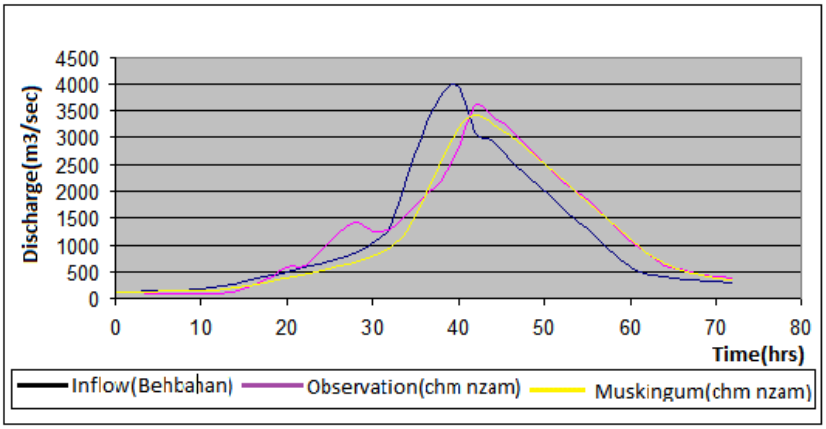

Fig. 2: Flood routing of Maroon river in the Chamnezam station by using Muskingum method.

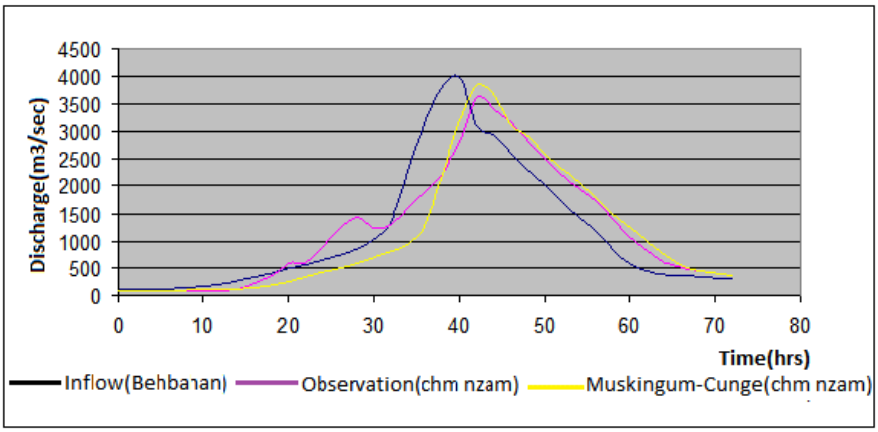

Fig. 3: Flood routing of Maroon river in the Chamnezam station by using Muskingum - Cunge method.

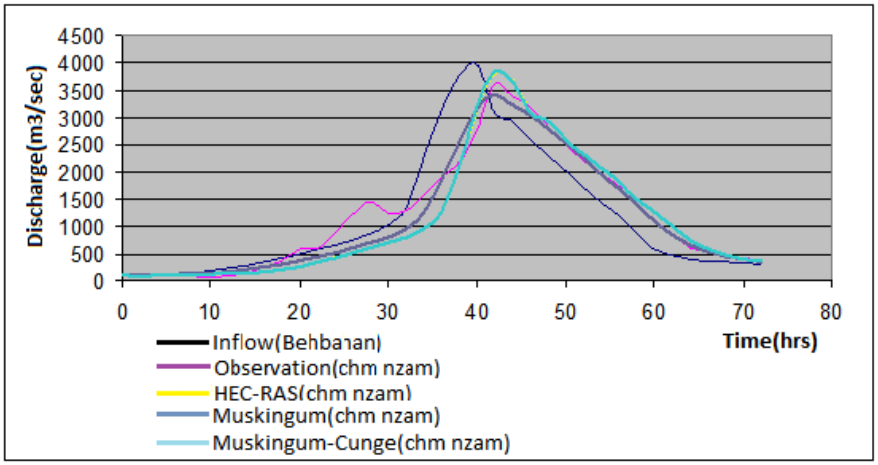

Fig. 4: Comparison of flood routing in the Maroon river in Chamnezam Station.

Results:

The models results show that the HEC-RAS model result is considerably better match with statistical data. The calculated maximum peak flow by HEC-RAS software compared with Muskingum and Muskingum - Cunge methods is closer to real results. To predict the flood damage is better to use the results of the HEC-RAS software.

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