



Full Length Article

The Survey of Surface Water Collecting Channels Performance in the Flood Crisis (Case Study: Sub-Basin Channels Of South Safarabad in Zanjan City)

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ABSTRACT

Flood is one of the natural disasters which creates much financial and damage in the world every year. Iran is located in the arid part of the world. Because of this, water resource especially water flow is the main effective factor in the farming's of cities and villages. So we can say that core of most big cities of Iran like Isfahan is located at the sides of the rivers. Zanjan is located and developed at the side of Zanjanroud and the development of the city has located various ravines of this river in the area of the city. In some cases, ravine beds are changed into underground or open channels. And natural channels are combined. On the other hand, in most of the created channels, short-term, mid-term, and long-term floods are not calculated. With the development of city, the lands are often changed into impermeability surfaces and runoff is increased. At the time of intensive rains, in most parts of Zanjan city, we will face with city flood and water logged which will create intensive damages. In this research, the researcher has investigated the surface water disposal channels in Zanjan city which are created on south Safarabad ravine. At first, the evaluation of the maximum discharge volume in the floods with high return period is done by using Zanjan metrological station statistics. Then, the disposal performance of this channel is compared with the maximum discharge volume. The result showed that the made channels in the sub-basin of south Safarabad is not made based on the maximum discharge. In flood time, the additional discharge is changed into crisis and will have created much damage.

Key words: Zanjan, flood hazards, water channel

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INTRODUCTION

The cities are geographical phenomena which are formed and developed during a period of time. For the most parts of the world, initial nucleus of cities have located near the water basins, especially next the rivers and then have been developed which due to the cities development they have invaded into rivers territory. So many buildings and structures of cities have been built on the rivers flood bed, In the most cities, rivers adjacent parts are perceived immune at short time, but on the long time, the flood damages these cities so much. One example of this is the devastating floods in Pakistan Floods in 2010 killed more than 2,000 people and more than 20 million people were left homeless. one of the reasons of much detriments of this flood, was invasion of cities and villages into the Send river territory. Also, in Iran for the reason of deficiency of water basins in the most native parts, initial nucleus of cities have been made and developed near the rivers, often, in Iran cities, because of invasion to rivers territories, it has been occurred much damage yes in this case, According to statistics, every year, 39 floods occurred in Iran. On the other hand, they are also on the rise [6]. Table 1 shows the flood statistics in this case.

Table 1: Flood in Iran cities since 1951 to 1991

Statistical period	Flood Number	Damaged cities	Damage(Billion) Amount
1951-1961	191	101	135.05
1961-1971	251	131	148.81
1971-1981	440	154	275.11
1981-1991	1008	239	691.53
Total	1890	625	1250.5

Also, In Zanjan Province, based on statistics during 1998-2003, of 73 Climate disasters, 51 cases was flood (Land use planning in Zanjan, 2011). Zanjan city is also included in the areas with a high risk of flooding. The crisis general manager of the Zanjan quotes "only in 2012, flood left a damage of 71 million dollars." All of these statistics show that the study of catchment area located on the cities adjacent is so important. These studies have been investigated in programs with so much scopes and results which their most important are:

1. Supplying of needed water for cities and industrial usage
2. Supplying of usable water of irrigation consumption and city gardening;
1. Specifying of water shed of surface supplies;
2. Evaluation of reserving operability of surface waters;
3. prediction of risks due to flood occurrence;
4. knowing of destruction power of surface waters for operations related to soil protection and watershed management;
5. adjunction allowance of surface waters in the cities nearby strata for generating of artificial lakes to city decoration;
6. Evaluation operability and conducting of surface waters in the intensity's and city crossings;
7. Supplying of equipment and discharge channels of surface waters [3].

Apprehension of natural and artificial phenomena and their variations effects on the hydraulic conditions of drainages has an important influence on minimizing of damages due to rivers flood in the cities environments. Among these, the basic problem is so much variation in the main water crosses under influence of city development and causing much limitation in drainage lines. Adjunction of sub basins with each other and also, changing in the natural line and generating of up- closed channels complicate this problem [4].

One of the main Specifications of draws is that they don't confine their operation to the current bed. For instance, water crosses can change heir position on the wide delta areas. Therefore, if the cities develop such lines, exactly they will locate under effect of drawschanging's and the city floods will duemuch damages in the city institutions [9]. In this research by determining the natural sub-basins of Zanjanroud which are located in Zanjan city, we attempt to determine the discharge in the floods with the return period of 2, 5, 50, and 100 years for the sub-basin of south Safarabad and changes on the ravine. Flood discharge is also adopted with the channels discharge and the critical area is determined in the city flood times.

RESEARCH METHOD

Research method is based on analytical way. Aerial photography and GIS software has been used as a tool. Topographic maps using Digital Elevation Model (DEM) and also, physiographic main indicators such as sub-basin area, main draw length, maximum and minimum height is created using ARCGIS .for obtaining Time of concentration Kirpich equation was used. Maximum water yield of each basin has been computed using assessment method and using the veining tension and time curves of synoptic station of Zanjan city which is just existing station in the middle of studding hound ring zone.

Study area

Study area of this research part of Zanjan province and is also part of Zanjan city which is in northwest of Iran. This city is center of town and the capital city of province. This city has a legal territory. In this research, catchment basins of legal territory are the aim of the study. It is in north latitude 36 degrees 34 minutes and 36 degrees 46 minutes, and East longitude 48 degrees 14 minutes and 48 degrees 44 minutes.

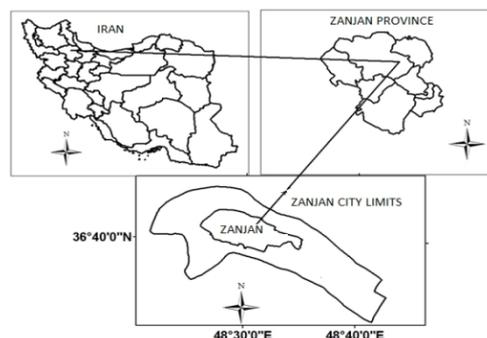


Figure 1: location of study area in Iran and Zanjan Province (Road and Urban Development Organization)

Zanjan is a big city and in recent years it had a population growth and so much development. An observation to population growth of this city represents that based on the statistics of the year 1921. It had 15000 citizens and based on the statics of the year 1956, It has 47159 citizens which the growth of 4.61 percent in a year, it has 340000 citizens in 2006; on the other hand, during recent halt of entry. Its population would be 7 holds from another way. Zanjan city area has been arrived from 165hectars in the year 1921 to 466 hectares in the year 1556 and to 4840 hectarsin2006. On the other hand, during 85 years, its area would be more the 29 olds. Because of Zanjan city development, many basins of sub-basins of Zanjanroud are located within the city limits. Based on this, because of changes of land using and asphaltting roads, runoff coefficient has been increased, and also, for Redirection of natural watercourse and their combination, the amount of the water entered into channels has been increased and will create a lot of problems in the future

Drainage Basin of study area

Zanjan city is formed on to the coniferous of Zanjanroud and 13.9 km of this river main way is located in the Zanjan city boundary and on the other hand several sub main of this river is located in the middle of city. This river hut formed from one main route and several sambaing routes, with the main length of draw of 110.9 km. that is a seasonal river and resources from the mountain Aghdagh in Soltaniyeh mountains and adjoins to well-known river Qezel Ozanat the extreme west of Zanjan Province in the west of Rajein village stressed recourses of this river is located two mountains Soltaniyeh is south and mountain Taram at north .An Average Water discharge of Zanjanroud is 4.72 cubic meters per second and its annual average discharge of it is 149 million cubic meters. The total of Drainage Basin of Zanjanroud is 5350 km of which 1897 sq. km is lowland and 3543 sq. km of it is mountainous. The total length of the river is 125 km. Zanjan city is located almost in the center of this Drainage Basin. Zanjanroud is divided into eight sub-categories in Zanjan city boundary. Figure 2 and 3show the location of Zanjanroud basin and the city of Zanjan.

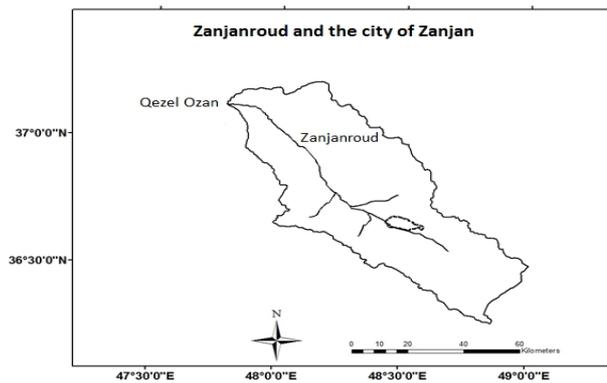


Figure 2: location of Zanjanroud and the city of Zanjan

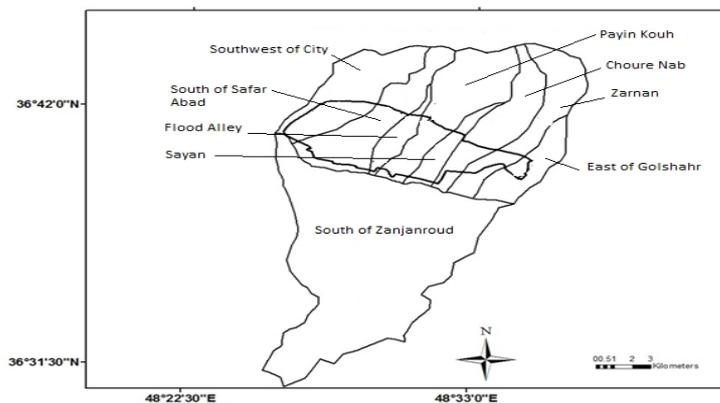


Figure 3: location of Subbasins of Zanjanroud and the city of Zanjan

Sub-basin physiographic of the study

The most important physiographic characteristics for each sub basin are: Area, basin Perimeter, Length of the main draw, Form Factor, Gravelius index, and Equivalent rectangular [1]. To study all sub-basins, all above items have calculated and represented in table 2.

Table 2: Physiographic characteristics of sub-basins

Subbasin	Area		basin Perimeter	Length of the main channel		Form Factor	Gravelius index	Equivalent rectangular
	City limits	Total area		the city limits	total channel length			
South Safar Abad	15.37	24.17	29	6.15	12.16	0.16	1.42	1.93

Time of concentration

Sub-basin of Zanjanroud is a kind of small basins. To obtain the Time of concentration for small basins, Kirpich equation was used. In table 3 Time of concentration for all sub-basins is shown.

$$T_c = 0.947 \times \left(\frac{L^3}{1H} \right)^{0.2227}$$

Where,

TC is Time of concentration in hour

L is length of water move meant in basin (km)

H is the Difference of elevation between focus amongst focus point and high level of basin (m) that is differential of elevation of highest and lowest point of basin

Table 3: Time of concentration for basins of Zanjanroud in Zanjan city boundary

Basin	Highest point (m)	Lowest point (m)	Height difference(m)	Channel length (km)	Concentration time (min)
South safar Abad	2200	1623	567	12.16	88.8

Intensity and Rainfall Time

To obtain the intensity and duration of rainfall data from synoptic station located in Meteorological Organization of Zanjan were used. Figure 4 shows the relationship between rainfall intensity and duration of the periods of 2, 5, 10, 25, 50, 100 years.

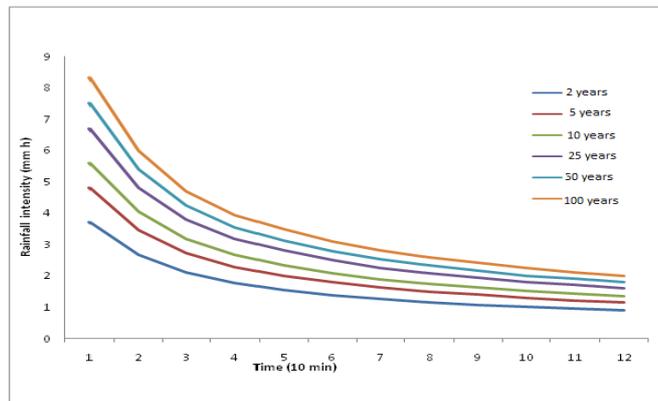


Figure 4: Rainfall intensity and duration of synoptic station in Zanjan

Computation of maximum water discharge in sub basins

For computation of maximum Water discharge in all sub basins, the following formula was used:

$$Q = 0.278CIA$$

Where,

Q=Maximum discharge of flood (Cubic meters per sec)

C= coefficient of water current of basin

I= Raining intensity (mm.hr)

A= plane of water bed basin (km²)[10].

Table 4: maximum discharge estimation for the periods of 2, 5, 10, 25, 50, 100 years

The process of disposal of surface waters from city channels

Output current of surface waters from city is an important problem which it has not a suitable organization, in fact, flood occurrence in city causes so much mortal and capital damages to the urban facilities. In this case the old structure of cities has several problems. Because in these structures. There are suitable channels for release of surface waters and on the other hand, for the reason of lack of the draining system in the old textures, Municipal wastewater also is added in critical conditions and cause high water volume and increase the damage to urban facilities. In the following surface water discharge channels characteristics of south Safarabad basin in Zanjanroud will be discussed.

South of Safar Abad

This sub basin is composed of two parts:

Metropolitan area

This basin includes the old boundary of city (old tower) that is not related to any flood beds and city channels. its limits are, from north: Earthen dam of south of Qods town, Northern Saadi Street, the street across to black alley, From south: Army Barracks, Homyoon street, Mozaffar Alley, Anvari alley until near building of post office of Zanjan, 17 shahrivar avenue, from west: Heydar Ali street, Gouniyeh Alley, Imam Khomeini St., Bab Al-Havaej Alley, Darreh Alley, and from east: Safa, Farhang and Javid streets and west channel of Azadi square.

This zone is the most problematic zone of Zanjan city, in which surface waters pour into water ways around the Sa'adi street, provincial organization, and Imam Khomeini and there is no main channel for drainage of surface waters. In fact, on the hand, Because of the central part of city: and the most trade parts and facilities of city are located in this part. It will have the most when flood occurs.

South Area of Safar Abad

This part starts from the west band of Karmandan town and continues along Gaen Alley to the south and then in the north of water department of Zanjan joins south channel of Qods town, and from north of Arg Gate, continues along the southwestern part. In the same direction along the airport Street, passes Eastern part of Forest Parkland after crossing under the road pours into the river. Now in the northern part of Darmangah neighborhood, this channel was closed and surface waters were changed into waste which smells so bad. It is necessary to channel it as soon as possible. This range noticed that storm of channel in the longtime floods, it causes so much damages.

CONCLUSION

Zanjan city, now, is faced with following problems in the most parts with respect to release of city surface waters. Which the most important are as follows:

1. Lack of operable and update system for release of surface
2. Lack of main channels of surface waters in metropolitan area of the
3. So much environment Existing problems in Zanjanroud because of pour in the waste water into pouring channels and entering of them to the Zanjanroud
4. lack of water Refinement system (recent refinery of zanjan city is located in 6 km of Tabriz road and the most surface waters and waste waters enter to Zanjanroud)

Regarding the existing of these problems in readiness of surface waters, there are problems in floods with the high regression Periods and especially in Flood with regression period of 50 years and 100 years center and west part of city will face with critics and it should be refined the release system of surface waters in there in these parts.

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