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Water tanks design in urban spaces designed for optimal use of flowing water from precipitation to climate

Hassan Bayadi[1], Mahdi Koohi[2]
[1](Department of Economic Managing and Vice chairman of the Tehran City Council)
[2](Department of Electronic Engineering Islamshahr Branch, Islamic Azad University, Tehran. Iran)

Abstract
Increasing global demand for the use of water in effect of uncontrolled population growth, industry growth, increasing the level of planting agricultural products as well as contaminating water resources especially surface runoffs due to mixing with wastewater and chemical pollutants caused abundant problems for communities and unpleasant periods for next generation. In this research with choosing and studying environmental condition and rain in Mashhad city which faced with extreme lack of water in order to save runoffs in raining seasons using them to meet the need of parks in the city, constructing suitable and adjacent reservoir was proposed. The rainfalls with different occurrence possibilities the amount of runoff was calculated by HEC-1 software. And surveying two parameters, i.e. peak and volume of runoff the best volume of reservoir is obtained which this prohibit destructive floods and use it in drought condition for irrigating green areas and plant covers. In this research in designing the amount of volume and building sample reservoir which followed by the ease of designing with less expenditure which showed efficiency of the above systems in optimal use of resources and saving in consumption.

KEYWORDS-**HEC-1,Software,Watertanks design, urban spaces.**

I. INTRODUCTION
Societies in which house, food and environment could provide human with well-being and comfort favorably, there made appropriate motivations for effort, movement, construction and cultural and industrial improvement were resulted. Study of ancient civilization show that if in some historical periods climate and environmental difficulties could make put barriers on the way of effort of construction, human with his innovation and invention minimized these constraints. Huge reservoir, ices, wells, wind breakers, and magnificent and tall buildings designed in the heart of the desert are the indication of industrious human's effort and generating well-being which occurred in the last century. Today, although civilized and developed human could, with the help of technology, make appropriate easy conditions with constructing towers and skyscrapers and developed cooling and heating systems. Nonetheless, such heavy expenses payment of mechanic systems as well as using fossil fuels for all people in all places is not possible. Thus, referring to the simple techniques which our antecedents applied to using environmental potentials can provide optimal well-being for majority of people in city or village. Out antecedents who had never access to cheap oil and gas only with the use of rain, wind, shining, sun and shadow factors and utilizing temperature differences in 24 hours provided optimal conditions for work and life. Use of these experiences with new knowledge can be helpful for today human in optimal water, fuel and energy consuming. As we know 34 percent of the earth is covered by water, 60 percent of animal body configuration and about 85 percent of plant active contests are formed by water [1] and the necessity of consistent exchanges of these elements between outer and inner environment of alive creature make it clear that without water life is impossible. With a look to the past we will find out that civilizations and populations were formed next to rivers or areas with ample water and fertilized grounds and when due to population increase or other reasons human have been forced to immigrate, they have chosen areas for residing to have access to water as easy as possible. Global population increase which entails more consumption in all fields especially increasing need for water, how will determine the human's future? This is a question which worries the most optimistic people. The history of saving and optimal use of water and water providing is begin from those days which human being chosen group life and the first residents were built next to rivers like the Nile, Tigris, Euphrates and Indus due to the easiness of supplying water. He learned transition from river flow and saving from lakes and where there was no access to the rivers to meet his needs he began to dig wells. Following the nature with digging groves and making suitable steeps on the ground transferred water to the consumption place and after thousands years with thought growth could make channels under the ground and by well transfer the underground water to the surface. Also using soil, stone and logs constructed dams in the water and little by little enhanced their use from saving into securing their

resident against floods, irrigating uphill grounds and getting energy (wind mill)[2,3].

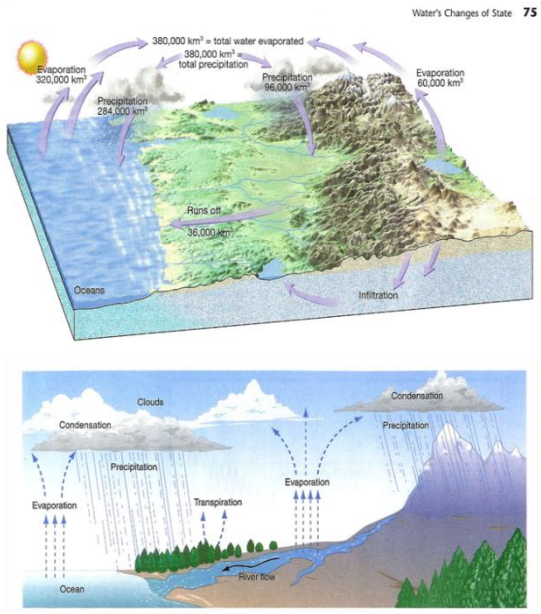
II. Importance And Necessity Of Implicit Subject

No doubt, among all the disasters which are threatening the earth now lack of water (as a crisis) will be turned to a great issue. United Nations organization has predicted that in the year of 2050 more than 5/4 people of the world will beexposed to injuries and losses resulted from lack and contamination of water. Now also every year 2 million children lose their life due to lack of access to healthy beverage water, daily 10 thousand children died due to diarrhea resulted from using polluted water and one third of people who are hospitalized is resulted from diseases which their primary reason is somehow related to water. The specialists believe that in the next century water will be rise as a political issue among countries and its economic value will be more than the most today expensive materials. Supplying healthy beverage water is often costly and about half of the world people don't have access to that. Unfortunately, in most of our cities this costly water is not used properly and the big part of it is wasted or is used in unnecessary cases [6]. The amount of water that exists on the earth and contributed in the water cycle is nearly fixed. The volume of existing water-rate of the earth is about 1454 million km sq. which according to table (1) is concentrated in different parts of the earth [6]. The huge bulk of this water exists in the oceans and is useless for drinking and agriculture.

Table(1): estimate of water quantity on earth

Gathering place	Exchange time(year)	Percent of total	Water volume (km1063)
oceans	3000	94.2	1370
Hypogeous source	5000	4.13	60
Ice layers	8000	1.65	24
Surface waters	7	0.019	28
earth wet	1	0.0055	80
rivers	0.031	0.00008	1200
aerosphere	0.027	0.00096	140

Regarding to this estimate fresh water-rate is estimated 40 million km sq. the existing water in the atmosphere which is vapor is only 35% of the whole fresh water, but because of short of time of exchange it has an important role in supplying and distributing water resources because evaporated water from oceans level and humid surfaces is transferred by horizontal and vertical flows of air and in all areas of the earth is purred as rain and snow. This was repeated continuously for about 40 years and thereby provided rivers water, undergroundresources, lakes and other resources of fresh water. As was showed in figure (1) [6].Thus it is necessary to supply fresh water in the raining area and runoff resulted from it be studied and utilized in advance. The world population formany reasons has a quick growth so that today the world population is over 5 billion people. Natural resources limit and quick growth of populationcaused that different societies are inneed ofplanning in different field. The goal of planning is optimal use of existing equipments favorably. This doesn't mean the reduction of consumption, but is thank to economic justifications and continuous use of existing resources. Dry and mild climate in a vast part of Iran and high growth of population caused planning in the field of fresh water resources to have high importance. Therefore, we can label in this field saving water behind dams, change in the way of irrigating, water consumption and so on. By huge investments in order to use and save water some small plans can be performed to prohibit wasting water area by area.



Figure(1). Diagram of water traveling in nature

III. Case Study In This Plan

In surveying every goal we should analyze basic information in a proper way. In the current plan two main goals, fighting against flood and water supplying and some lateral goals were proposed which here it will suffice to deal with the main goals and regarding to that the suggested structure is the same and just they are different in details and also various aspects of the plan have many shared parts, after determining informational needs of each of these goals, the data are rank according to the priority and explained in the next section in title of "recognizing studying area". Now, here we survey informational aspects and needs primarily on hydraulic structure that can reduce the amount of flood by collecting runoff and then the same way is applied to a water supply resource according to the

use. According to the UNICCO surveys on water studies, using hydrologic and planning of collecting systems and prohibiting urban floods four data groups should be studied which are:
1-Physiographic features of basin: topography, steep, geographical position, type of soil, …
2-The data related to surface waters: rivers, streams, dams, and resources of surface water.
3-Underground waters and soil features,
4-climate forecasting data: rain, temperature, humid…

IV. OPPOSITION AGAINST FLOOD

1-Generating water equipment out of the cities to protect them from entering up floods or floods resulted from overflow of basins and rivers adjacent to the cities.
2-Building barriers out of cities to trap the floods or slow them down in order to increase the time of concentration in the lower parts.
3-Generating water equipment inside the cities and preserving existing floods to control and entered floods.
4-Using urban facilities and their physiographic features in urban development design in order to guide and natural discharge of floods in city.
5-Enacting and performing constructing rules to reinforce urban buildings resistance against flood destructive effects. Among the above cases, three cases are related to the inside of the cities and two cases are related to the out of the cities which it indicating the importance of city constraint in controlling floods. Thus in controlling floods projects we can't ignore the role of reinforcing urban constraint by infeasibility of their covered surface.

V. WATER PROVIDING

In recent years some big and subjective plans occasionally for making changes in area climate were represented which are not acceptable, like: transferring …rivers by channels, transferring the water from lakes to deserts in building lakes there, making channels and cutting mountains to transfer humid air and building lakes by fossilized water. Now it is determined that with the above plans not only can change the climate of the area, but there will arise some new and unknown problems. Thus, we should seek for solutions while is accordance with the nature, satisfy our present and future needs. The increase of productivity and the optimal use of rain is accepted by all the responsible people and specialists and finding a practical way to this goal "supplying water of each area from that area" needs further investigating and research.

VI. AN OVERVIEW TO WATER ISSUE IN DRY AREAS

We will talk in detail on distributing criteria of areas and applying the word humid, semi-humid, semi-desert, desert and… in physical and climate features of Khorasan. In this part we deal with the importance of supplying water for dry areas. Dry and semi-dry areas are covered most of the lands on the earth that there exists relatively much population and due to bad climate conditions always faced with many problems. About 90 percent of Iran has dry and semi-dry weather [4]. In dry areas according to required conditions to form soil and other effective factors in its change and evolution, both fertilized soil and usable water are low, but the issue of water is more important than other limiting factors because if there is appropriate water sufficiently we can somehow modify inappropriate soil. And if climate conditions are incompatible we can abate them in part, e.g.: with mo0re irrigation we can null vapor unfavorable effect and use the warmth of these areas for better performance of agriculture corpses and/or according to the length of daylight and also being prolonged the time of growing season in desert and dry areas using optimal irrigating we can produce different agriculture products. And also when the tempest is regarded as the restricting factor in the area we can make alive wind breakers with planting trees and irrigating them. But in dry areas lack of rain causes that the use of surface waters and underground waters not to meet the residents of this area. Thus, it is necessary for a better and more use of that little rain in these areas help to solve this problem in part.

VII. GENERATING REQUIRED WATER RESOURCES

A way of more productivity is also utilizing rainfalls which are the intention of the current plan. Saving runoff resulted from rains is in resources which are generated especially for this purpose and are considered to be exploited when is needed. A reservoir can be built for many reasons and whatever application of it is justifiable for the amount of investment in this way. Because building a hydraulic building also should have economic justification like other structures. However, the serious lack of water and specialists' worrying prediction and international communities on this lack for future decade and also lack of substitute and the dependence of life on water justifies every kind of investment. But the restriction of equipments makes us to put some measure on the top which need less fiscal resources and have high efficiency. For this purpose, in this section we will mention goals and applications of suggestedwater reservoir and required data for such structures.Data analysis is presented in the next section after proposing information jointly with flood section.

VIII. SELECTING THE STUDY AREA AND PERFORMING METHOD

It has been many years that we were witnessing occurrence of destructive floods in some provinces such as the vast province of Khorasan. And a phenomenon called drought is seriously threatening most of the areas. No doubt, lack ofwater was one of the most important issues which obsessed the mind of most people in charge especially planners of agriculture section and urban affairs so that the citizens of these areas hardly can supply their beverage water and use it in form of rationing. one of the reasonsof choosing Mashhad city in respect with optimal use of urban runoffs first is thank to its population and also 12 million pilgrims and tourists which were affected by the destructive drought effects that in the year of 1378, paid 10 billion Rials for irrigation and in most areas of the city also to water the parks they use beverage water that at least with studying this plan we can use season runoffs which are resulted from rainfalls in order to supply the water of parks of this city which should be the pattern of religious cities in the world.

IX. IN SELECTING THE AREA THE FOLLOWING FACTORS SHOULD BE TAKEN INTO ACCOUNT:

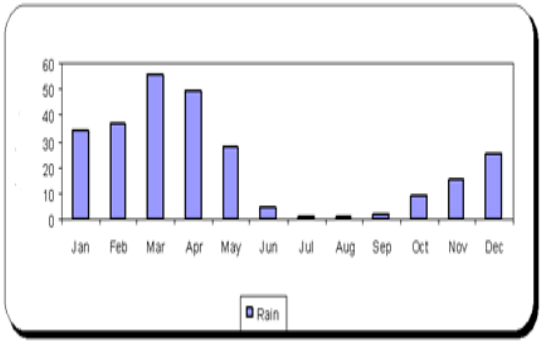
1-Hydrologic balance: the earth hydrologic system regarding to the amount of existing water being restricted we can consider a close system, but we survey small system of basin of Mashhad plain that is placed in a part of hydrologic cycle flow path.

2-Geographical situation: Mashhad town with a population of 2500000 are resided and annually 1500000 of passengers and pilgrims is a religious-tourism city. The average altitude of this city is 110 and longitude of 59 degree and 38 east ….of 36 degree has a width of 200 km.

3-climate situation: due to that in many cases climate parameters in synoptic scale (those maps which showed about one fourth of the use of the earth) become meaningful and also masses of air usually cover a big area of the country. It is necessary that local climate be studied as a part of whole.

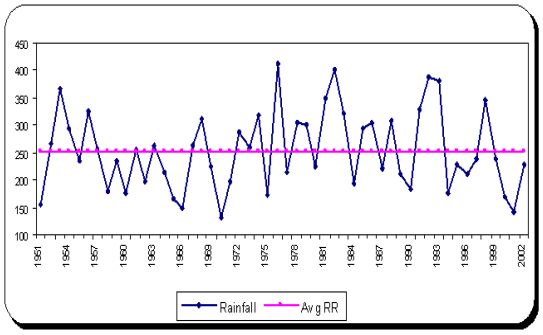
X. COLLECTING INFORMATION AND FINDINGS OF RESEARCH

Mashhad has a winter raining regime and both forms of solid and liquid is seen. Basically raining in areas can be resulted from a vast air system in large scale or locally be in an air mass. The typical type of local raining is thunder. According to this that two main goals of the plan are preventing damages of flood and saving water for use, thus the issue of raining like any other hydrologic plan both generally and in detailed be surveyed. On one hand, entering water in the area is almost allocated to rain, thus rainfalls are the base of water budget. In this paper the statistical of rain of Mashhad weather in 40 recent years was examined and also notable results were obtained, as shown in figure (2).



Figure(2)-Mash had Monthly Rain Average

The average of raining in Mashhad during a statistical period of 1960-2000 is of 259 mm. rainfalls mostly occurred in winter and the maximum average of monthly rain is of 5/55 mm in March and the minimum average of monthly rain was o 6/0 mm in July. Graphs (2-4) show the average raining of weather station of Mashhad during the statistical period. The maximum 24 hours rainfall in 30th of December 1970 was reported of 47 mm. rainfall collection annually during statistical period with mobile averages of 3 and 5 years which are showed in figures (3) and (4) annually rain graph and specialists' opinion [7] verified the absent of this in annual rainfalls but in mobile average graphs less rain and much rain periods are determined.

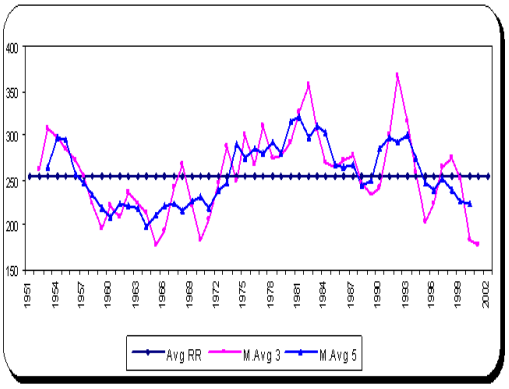


Figure(3)-Mashhad average long-term and rain yearly

Of course the amount of rainfalls in this city is low, but this low level is notable because regarding to the definition of rain mm (one mm is equal to one liter water in one square meter or ten cubic meter in one acre) and regarding to the amount of mean rainfall with a simple calculation we find that the average of rainfalls is annually in each acre 2590=10*295 cubic meter. The vast of Mashhad city is about 200 km and the extension of

Mashhad area is 16500 km with allocating the above calculation we can conclude that:
The average of annual rainfalls in Mashhad city and Mashhad province is:

The amount of water in cubic meters=the mean of rainfall*area in acre*10
In Mashhad city→259*100*200*10=51800000
InMashhadprovince→259*100*16500*10=4273500000



Figure(4)-Mashhad average changing rain

Although for providing reservoirs or constructing dams and also hydraulic designs information on the whole annual rainfall is necessary, in the most studies more details such as …of rain time and for calculating…and flood even the elements of one rainfall like its intense, duration and the abundance of occurrence should be examined necessarily because especial features of flood such as volume of flood, discharge or peak flow and the time of getting this discharge is depended to rain features as the most important factors of making floods and erosion and so on. The above elements are as follow:

1-Duration or continuity (from the beginning to the end of rainfalls).
2-Intensity (the amount of rain in time unit, mm per hour).
3- Abundance of occurrence (the average of the number of years which there is between two similar raining).

While the most extreme flood is resulted from a rain which its insistence is equal to basin concentration time and the time of a physical parameter which its amount is different for each basin, thus if we want to calculate the amount of flood in an area for different basins we should have the maximum intensity of rain in continuities which its amount is equal to the time of concentration of basin. So, to have relationship and a graph on which we can estimate the rainfall for different continuities is that of main requirement which is used in water structure design. On the other hand water structurelike: bridge, flood block, dam, drainage, collecting streams for sewage and whatever related according to the importance and sensitivity to destruction or the amount of money that is spent for building it or dangers which are resulted from ruining is determinedwith return period. Thus, intensity or rainfall that is used for certain continuity in its design should be related to considered return period.Rain intensity changes into return period ofa statisticalfunction are possibilities that have different amount for every climate area.Having this relationship is that of design requirements in waterworks. From integration of the above relationship we can achieve uniform functions or graphs on which we can estimate the amount intensity in different continuities and return periods. The aim of this report is representing such relationships and graphs for the targeted station. These functions and graphs which have been extracted from existing data is represented in a way that the amount of rain intensity in 5 minutes to 12 hours continuities in return periods of 20, 25, 50, 100 years are obtained. Choosing rain continuality changes range and standard return periods is for their high application which we deal with them in water structure design or whatever similar.

XI.PLANSIMULATIONAND IMPLEMENTATION

In simulating our plan HEC-1 software was used. One of the advantages of using HEC-1 in comparison to other models is the simple way of organizing information. HEC-1 determines format and information of basin and formats of discharge using some input cards or codes. HEC-1 is one 6 soft wares in the name of HEC which is provided by American engineers. In fact this software is simulation software for runoff rainfall; and in a general definition is able to estimate the resulted runoff by using an observed rain.
The most important information which can be obtained if a certain rain entered is the amount of discharge hydrograph from urban area. The advantage of using this method is determining the discharge volume and amount of discharge peak. The obtained information from this method is much more completed than the two other, while it needs more comprehensive information than them. Another important difference between them is that is has more complex calculations than those two previous usually for this method due to high calculations the most common software is used. One of the most known and used program in this field is HEC-1. In order to work with this software the following information are necessary.
1-Rain information: This information can be given to the program as rain hydrograph, certain information of rain gauge, likely rain and soon.
2-Damages information: This information is parameters related to different methods of

calculating damages in hydrology science. HEC-1 is able to consider different methods for calculating damages of rain and of course introducing every certain method, its related information must be given to the program.
3-Unit hydrograph information: unit hydrograph is in fact information which is obtained from previous memory of system during different rains. In the case of lack of this information we can use approximate artificial unit hydrograph in calculation.

XII. DETERMINING APPROPRIATE VOLUME OF RESERVOIR USING HEC-1

HEC is a software used in hydrology engineering and is used in order to simulating rain in a basin. In this project in order to determine required volume for saving runoffs resulted from rain this software has been used. To perform calculations related to simulation of runoff rain we need to determine 3 main factors for the study area, which are:
1-Rainfall 2- unit hydrograph 3. The amount of damage

XIII.CALCULATING SUGGESTED RESERVOIR VOLUME

These days, there are thunders with different intensity in order to determine required volume for gathering these runoffs during a year it is assumed that we have in average thunder for each mentioned day and the number of occurrence is considered to match with return period of that rain so that an occurrence possibility of two years rain is 50 percent rain and for 100 years is 01/0. So the required volume for gathering the number of thunders annually is calculated as follow:
1440*1/2+3600*0/2+3960*0/1+4320*0/05+4680*0/02+5040*0/01*7/7=16909/2170003 m
Thus, a reservoir with volume of 170003 is suggested for specified area. Following that we can determine other reservoirs for other areas which are to gather runoffs.

THE OBTAINED RESULTS FROM PERFORMING HEC-1 SOFTWARE AS RUNOFF VOLUME:

resulted from rain with different return periods are showed in table(2). As it is said in determining rain intensity for different states we considered fixed continuity which regarding to likewise ratio between rain and continuity of this premise doesn't have that much effect on determining runoff volume of whole rain.
In order to design a reservoir for gathering surface waters and analysis should be conducted on the number and the possibility of occurrence of these thunders during a year. Mashhad city has the mean of annual rain of 3/259 mm. the main distribution of this rain is as scattered thunders with a shallow depth (less than 10mm). Such rains do not make runoffs or flood in urban areas and many of them are not retainable because has a high percent of damages. The mean of the days which Mashhad faced is 7/7 days per year.

Table(2): resulted from rain with different return periods

Result of run off volume(yr)	4320	5/02	20	3960	3600	1440
Result of run offvolume(mm/hr)	4680	5/72	50	3960	3600	1440
Result of runoff volume(m3)	5040	6/23	100	3960	3600	1440

XIV. CONCLUSION

Supplying water for different consumers is one of the most vital activities for dry and semi-dry areas. Whatever activity to increase the percent of…. existing water resources includes high profit for the area. In this paper by using a systematic approach to the issue of optimal exploitation from existing water resources, we tried to propose a method to prevent damages resulted from rain in the best way possible. Using water resources often was considered in form of big and costly projects. Such projects in respect with high volume of and high investment are in need of much time and cost to be implemented. It is the case, when we can take advantage of many facilities by a proper and systematic approach to the environment and at the same time we can save much costs and damages. One of the existing and related challenges to this issue is urban runoffs. These runoffs are direct consequences of urbanity and urban life which often cause many problems because water is flown in pavements, streets, and settlements. In this research a solution has been proposed in which we can use existing unwanted water resources resulted from rain by using this certain position in urban areas. Gathering and removing runoffs resulted from rain in urban lands is implied as kind of security, Sanitary and well-being services which should be presented to urbanite community this services in addition to tangible profits and valuable has some intangible profits which affect procedure of development. According to the all studies gathering runoffs, directing them to the water reservoirs and using them in dry season is suggested to municipalities and owners of big complexes because in this method:

Supplying water is done with the less cost.

1-uses facilities and potential of the area and reduces the danger of floods.
2-can use existing natural positions like holes and artificial complications.
3-replacing small and cheap with high efficiency projects with big and costly projects
4-generating and reinforcing contribution culture and saving in water is possible.
In this respect we can present suggestions which of course are also presented in previous cases that are as follow:

1- Surveying and finding existing different areas in the city which has the appropriate and similar potential to the study place of this project in order to implement the project the best way possible
2- designing certain place of reservoir in a way that in addition to gathering water it reduces peak power and resulted floods volume
3- using natural positions like holes or natural and artificial complications for building such reservoirs
4- using many small and cheap projects as alternative for a big and costly project.
5- 5- We hope that the method and presented results in this thesis will be a step toward developing water supply position of the urban areas especially those which have dry climate.

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Hassan Bayadi received B.S degree From the university of Karaj in I.E Engineering and the M.S degree in I.E engineering from the university Of science &technology of Mazandaran Currently, he is an Urban planning researcher with the Department of I.E engineering Elmikarbordi university.