ISSN (Online) 2456-1290
International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)
Special Issue
.inSIGHT'18,4th National Level Construction Techies Conference
Advances in Infrastructure Development and Transportation Systems in Developing India.

Naher-E-Ambari a Case Study: Rebirth and Recommandation for Medivial Water Supply System (Part I)

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***Abstract*— This paper present on the ancient water management system (Nahar-E-Ambari) was one of the pure and preferable sources of water in Aurangabad city. And it's built by Malik Ambar in 1617 A.D. it is design for population of 7 Lakh. On the high land around the city from north, east and south wherever the circumstances allowed the engineers of the period brought down Nahar in Aurangabad city. In city of Aurangabad was having number of Nahars of pure minerals subterranean drinking water.**

The inhabitances of Aurangabad where being benefitted by this water supply system since 300 years regularly without any tax. In over paper, the technical detail of Nahar system is discussed in depth. It is world 2nd number water management system based on symphonic action in working condition, but now days it was break down and with the age, the rupture and break down began and Destroy. In this report we will study and analyzing parameters like mapping of aqueduct and manholes by GPS water quality parameters (physical, chemical and biological) and we recommended various norms like renewal of Nahars, water filter plant for at specific station, replacement of old pipeline system, various repairing method improve water quality and utilization of water use for in public sector like drinking, gardening, street washing, public toilets.

Keywords: Nahar-E-Ambari, GPS, Siphon, Air Towers, Gaimukh Aqueduct, Google Earth, etc.

I. INTRODUCTION

In the history of Aurangabad Malik amber in 1617 A.D. introduced memorable system of water supply. Aurangabad city always faced scarcity of water and there were no big dams or water reservoirs in the vicinity. Owing to hard rock and dry land it was very difficult to construct the pillars to supply water to the town. So this was the great feat of medieval engineering achievement. Malik amber in 1617 ad discovered subterranean water table of mountainous elevated valleys in north of Aurangabad. He practically manipulated and procured a stable perennial water supply for a population of 50000 of people by constructing his unique wonderful aqueduct by name Khair – E- Jari. The old water supply system is the reminiscent of medieval period. When we enter the town, we find numerous buildings, palaces, tombs, mosque, fortifications around the town, but same time, we see high rectangular or round pillars erected on the roadsides. These high pillars are called "distribution chambers" which clearly indicate the medieval system of supplying water.

The city of Aurangabad was having number of Nahars of pure mineral subterranean drinking water. This practice of construction of such aqueducts continued from the period of Malik Ambar (1617) up to the time of Aurangzeb and Asif Jan (1803) for a period of about two centuries. On the high lands around the city from north, east and south wherever the circumstances allowed the engineers of the period brought down Nahars in Aurangabad city.

Personalities like Malik amber, shah Mehmood of Panchakki and Shah Ali Nehri are founders, designers and planners of these three famous, wonderful easy and useful aqueduct system of Aurangabad. During the long period of three and half centuries this unique, god gifted old water supply system prevailed and lasted up till now, the inhabitants of Aurangabad were being benefited by this water supply system since three hundred years regularly without any tax.

During the military activities, Malik Ambar discovered the Kham river valley and its large natural basin of about 150 sq. Miles over head of a well planned and

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layout city. Malik amber has designed the construction of the aqueduct in a very simple appearance and natural way underneath the river bed of Sawangi and Kham River which has got number of man holes over head called Abgir Nali Upto Gaimukh. An earthen dam was constructed on the river Kham on the north of Aurangabad city.

NAHAR-E-AMBARI:

Nahar-E-Ambari is a living memorial of Malik Ambar. He constructed this canal in 1029 A.D and died in 1035. This is the biggest of all canals and still exists. In the Northen direction of Aurangabad there is a range of mountains, but the most famous mount is Ju-Ban. Adjacent to this mountain the Sangvi town is located. A mile away from this town is the origin of this canal. The total length of this canal is 4450 m. There was no distinct mark on this canal before 400m. But after 400m, Fateh Bhai, administrator of Aurangabad marked on this canal from beginning to the end. He also constructed in his supervision high & strong man holes. Due to these man-holes the cleaning & maintenance of the canal was easy. At the beginning of this site there is a man-hole &at the end of it is Gaimukh. The difference of height these sites are 140 feet from the highest point of the town its starting point is 48.8 m high. So the flow of this canal is based on the natural process of gravity modern engineers think, that it is underground streams of water. At the beginning man-hole was buff with porous bricks so that large quantity of water enter into it & the flow of natural underground streams of water also continues. At the complete length of this canal there are 100 man-holes through these the cleaning of the canal is performed. SawangiRiver is almost parallel to this canal. On one side of the river is canal Ambri & on the other side which is comparatively higher is Nahar-e-Nasrullah. The floor of the canal is lower at many places the canal is dug in the porous layers of the ground so that large quantity of water may be supplied by the percolation. The peculiarity of this canal is that the water filters into it and the quantity of water also increases. At the beginning, they confined the natural underground flowing water and diverted into the canal subsequently so that the canal flows permanently.

The canal is in fact an underground stream of water. Its sectional area at the length of the canal is different, sometimes it is broader & sometimes it is narrow. This difference is due to the slope of land. Its shape and cutting is normally rectangular but sometimes it is trapezoidal the average width is 0.75 m and height is from0.75 m to 4.5 m. The canal is dug very deep under the ground but there is no masonry work on its two vertical sides. But above the vertical sides an arch of lime & brick is built. Bricks are red in colour and smaller in size. The rise of the arch is not more than 7 to 9 cm. The conduit of this canal is like a tunnel. Above this arch, earth filling is done so at some places the agriculture is also done. Man holes are strong and high rectangular tanks on which are stone coverings are fitted. So that the time needs it can be removed easily and the man could enter into it and clean it. There is a network of masonry pipe from Gaimukh. There is a particular reason because from that point, the land is uneven so it was not possible to supply water by the siphon system. There were two branches of the pipe lines one used to go Upto Bara Dari Khurd-E-Kallan and second used to supply water to the remaining population of the town. The clay pipes are circular and its radius is 20 cm at the ends of these pipes are sockets by which they were connected and then they become solid and also the size of the pipe becomes longer. On the line of pipe in the town there are some hollow pillars made up of bricks & lime & they are called air-tower.

The purpose of the construction of these air-towers was that the air of pipes should be passed because these pipes are weak and they cannot bear the pressure of water secondly each air tower created pressure in water and in order to create velocity in the forward line of pipes so that it could get head of water and maintain balance. These air towers are often circular or rectangular. Out of these some are higher and some are less high for the pressure and head of water. In the solid towers, at the proper distance, there are manholes for the distribution of water. Irrespective of weather, the water was distributed in the different streets through these holes to the taps. Whenever they wanted to close these holes, the lids of wood were fitted. Out of these towers, they are some main (principal) towers & some are branch tower. The branch towers were connected to the common tanks and houses. Each tower has two vertical lines of pipes & they are parallel from pipe the water comes up and falls down from the other pipes and

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flows faster forward. For common people there were tanks in each street royal& rich people used the pipe connection and tap water stored water in the tanks of their garden.

The recent water supply system of Aurangabad is a link of this chain. In this recent system the whole length of the canal is kept like the past UptoGaimukh but they some changes e.g. in the town instead of clay-pipe the new system pipes are laid down. This modern system of the net of taps is a part and pareel of Ambari system. Initially there were proposals of constructing a huge dam for the water supply of the town. But this scheme was very expensive and there were no huge sources of water like dam, river and wells in the town. So keeping in view the high expenditure required for this project the director of the water supply Mr.Ahmad Mirza continued Nahar-E-Ambari as a source of water which is completed in the supervision of the chief and asst. Engineer. After the cleaning and restoration of the Nahar-e-Ambari canal at some distance of Gaimukh a setting tank is constructed. First the water stores in this tank and accumulates into clear water chamber and then by the chemical action it is cleaned and then falls down into service reservoir. Distribution reservoir is made inside Delhi gate. In this reservoir filtered water is deposited and the from here it is distributed in the town cleaning of water is done either by the bleaching powder or chlorine. Although there is no heavy rains in the recent years and while cleaning the canal all the old principles were not followed, with which the ancestors were familiar. However, the Nahar-E-Ambari is being utilized for the supply of water except a few Hanes which are at the highest level. In older times the water was distributed permanently. But in recent times it is done intermittently and that is two hrs in the morning and two hrs in the evening. From Gaimukh to inside city instead of clay pipes the metallic pipes are put so that they could bear the pressure of water. In these pipes the main pipe of R.C.C. is put and others are metallic. Another small distribution of water supply was made little away from the Paithan gate at Kala Chabotra. From this centre the water was supplied to a number of lanes. This Kala Chabotra is constructed by MalikAmbar. He uses to check his military from here. This reservoir is at higher level so the pump was used to fill the reservoir. For common people in the various lanes common tap or public stand post were founded. In the hours of rich needy the connection of water was given by the iron pipes.

When we compare our water supply system with the present system, we find a huge difference in indigenous system a single paisa was not spent abroad, but the whole amount was spent at the same place and if is utilized in the vicinity where there was no extra expenditure in filtering, depositing, cleaning or distributing the water. The water supply system of Aurangabad is on a very large scale but for the maintenance hardly little amount is spent and despite the meager spent on this old project, it continues to supply water over 300 years.

Planning Designing and Construction of Old Water Supply System:

The old system of water supply was dependent on the canals. If we try to find out the origin of these canals outside the town we will find only huge land fields. At the origin there is neither any construction work nor deposit of water. As the origin of these canals are either in the lap of mountain or in the vicinity of river. Under the principle of gravitational power these canals were dug in the porous levels of land and they flow in the natural way. Geographically the town is surrounded by the mountains from all sides. The town is located in the valley. Hence most of the canals start from the mountainous field and end in the town. The most interesting and absorbing thing is the simplicity and uniqueness of these canals. There is no technical complication but still it is running successfully. Each canal is divided into two parts. First is conduit (large pipe or water way) and the second part is a net of masonry pipes on which they erected rectangular or round pillars sometimes they are higher in a size and sometimes smaller. The cross sectional area of these conduits is based on the old engineering hydraulic & design system is an engineering marvel. In order to cope up with growing population despite Ambri- Nahar (canal) they dug several canals.

LIST OF NEHARS:

Nahar – E – Palsi, Nahar – E – Nasrullah, Nahar – E - Pan-Chakki, Nahar – E - Lal Mahal, Nahar – E – Kiradpura, Nahar – E – Garkheda, Nahar – E – Koila, Nahar – E - Darga – Shab Ali Nahri, Nahar – E –

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Chausar, Nahar – E - Darga Hazrat Shab Noor Hashmi, Nahar – E – Begampura And Nahar – E – Chavni.
They utilize the local material and the peculiarity of these canals lies in the principle that the water stores and filters into it. MalikAmbar was the commander of the Nizam Shahi kings and subedar of Daultabad: he was dynamic commander and a great engineer his system of water supply is first of its kind and also the last. In the year 1604, MalikAmbar made 'Khadki" present Aurangabad as his head-quarter and named it as Fateh Nagar. He introduced the system of water-supply for the public utility and this well-Organized system is known as canal Ambari or Nahar-E-Ambari. In 1653, when Aurangzeb was appointed as the subedar of Deccan he made Fateh Nagar as his capital and named it as Aurangabad. When he became the emperor of the Mughal Empire he declared Aurangabad as the capital of the Mughal Empire. Owing to this reason the population of time grew faster and acuter scarcity of water was felt. In order to supply water to the growing population he extended the system of water supply of Ambari and new canals were also dug.It is described that at the peak of Aurangzeb's reign the population of Aurangabad was about two Lakhs. Besides Nahar-e-Ambari there were 12 (twelve) canals which were sufficient to supply ample water to the town some of them are still functioning properly and rest of them can become permanent source of supplying water after the minor repairs.

LITERATURE REVIEW:

Vicinity-Shaikh Afreen e.al.[1] report no.ISSN: 2348 – 604x international science journals 2014. Study of aquatic protozoan in neher-e-Ambari in Aurangabad. International science journals 2014. The present research work covers systematic study of morphology and prevalence of free living protozoan from fresh water bodies of neher-e-ambary in Aurangabad region of Maharashtra (India). During this study total number of 15 species have been recorded i.e. 10 species of ciliates, 5 species flagellates and some actinopods, rhizopods have been reported. Most of the ciliates and flagellate species which are obtained directly from water samples or from various type of culture viz; boiled egg infusion, yeast infusion, phaseala radiates, lens culinary (lentil) infusion, rice infusion, wheat infusion, hay infusion,etc.

Pradeep Purandaree [2] report no economic & political weeklyJune 22, 2013 vol xlviii no 25. Water governance and droughts in Marathwada- 2012. An attempt has been made here to review the 2012 drought in the Marathwada region of Maharashtra based on various issues as reported in the Aurangabad edition of the state's newspapers.

Pratik V. Mane,[3] NICMAR, and Goa. International journal of science, engineering research & emerging technology, vol. 1, issue. 1, January 2017engineering aspects of neher-e-Ambari and its necessity in Aurangabad (Maharashtra).study and analyze the hydraulic characteristics of Nahar-e-Ambari constructed in 1968, study the spread of the Nahar-e-Ambari aqueduct system over the Aurangabad city, to analyze a scope / feasibility regarding utility of the aqueduct in the existing water supply system of Aurangabad, Nahar-e-Ambari water course, construction of aqueduct, siphon system aqueduct, air towers, pioneer of a unique everlasting aqueduct of the world, underground water through aqueduct, advantages.

P.A.Sadgir and U.J.kahalekar.[4]national seminar on water & culture, Hampi, Bellary dist. 25-27, June 2007dying wisdom of medieval water management of Aurangabad city-P.A.Sadgir and U.J.kahalekar.National seminar on water & culture, Hampi Bellary dist. 25-27, June 2007. Planning designing and construction of old water supply system the old system of water supply was dependent on the canals. If we try to find out the origin of these canals outside the town we will find only huge land fields. At the origin there is neither any construction work nor deposit of water. As the origin of these canals are either in the lap of mountain or in the vicinity of river.

Mr.Dr.Shaikh Ramzan[5]400 years under ground living Aqueducts. This book written by Dr. Sheikh Ramzan in 2010 and his study of all nahar exist in Aurangabad and camplit his Ph.D. on this subject. His conduct following points on this book, Nahar-e-Ambari aqueduct, Gaimukh, Nahar-e-panchakki, different types of aqueduct, manholes on Nahars, earthen pipelines in tunnels, siphon systems, air towers, junctions of towers, photos, maps, sketches.

Dr.Dilip B.Boralkar e.al [6] submitted todistrict planning & development councilunder the aegis ofdistrict magistrate & collectorAurangabad 2012.project proposal on bioremediation of sewage disposal in the Kham River atAurangabad(Maharashtra) Aurangabad is not blessed with unlimited water resources. The city has crossed population total of one million. There is tremendous pressure on limited drinking water availability and its distribution in the city. The city is generating sewage at about 100 million liters per day (MLD). Untreated sewage disposal is of concern as it is cause of water pollution.

W. James marold,e.a[7] water storage, transport, and distribution-aqueducts, tunnels, canals, pipelines, siphons, and water distribution.Tunnels: lining, grouting, rock bolts, blasting, boring, And canals: lining, routing, control structures, siphons: inverted, head recovery, pump discharge, pipe materials, hydraulics, equalization storage, carrying capacity, cross connections.

Evan James Dempsey [8]report no-3116 522 2 the aqueducts of ancient RomeFebruary 2009. This thesis will examine the eleven main aqueducts that fed the city of Rome; how they were made, what they were made of, when and how they were repaired, the tools that were used to make them, the skills needed to make them and how the prevailing political climate that existed at the time influenced the construction of each aqueduct. As far as possible, the distribution of water from each aqueduct will be examined, but this aspect may be considered an insoluble problem.

Jean deloche [9] report no- 48.2 (2013) 207-217, water supply systems of the senji (gingee) fortinsouth India (16-18th century),Indian journal of history of science 2012. The domestic water supply systems of the fort of senji in the Tamil country employed rain water storage ponds and catchment tanks for the supply of the urban settlement, thus exploiting the hydrological environment to the maximum advantage by using the available technologies. In the fort, two water systems which correspond to two periods of great hydraulic works were constructed (deloche 2005, pp. 189-200).
S. Krishna Kumar e.al. [10]. Report no-apple water science (2015) 5:335–343 doi 10.1007/s13201-014-0196-4. Hydro-geochemistry and application of water quality index (WQI) for groundwater quality assessment, Anna nagar, part of Chennai city, Tamilnadu, India. Published with open access at springerlink.com 2014. Ground water contamination in urban environment is a major issue and is complicated by large number of potential source of contamination (jayaprakash et al. 2008). India has wide spectral variations of meteorological, materials and methods, chemical of physico-chemical parameters, correlation matrix.

R. T. Sniegocki and j. E. Reed [11] report no- 1615-d principles of siphons with respect to the artificial-recharge studies in the Grand Prairie region Arkansas, geological survey water-supply paper1963. In 1953 the Grand Prairie region of Arkansas was -elected for an investigation of the principles or artificially recharger, Ground-water reservoirs in alluvial deposits through wells. This area in the coastal plain of east-central Arkansas provided a large natural laboratory in which studies of general interest could be made. The U.S. army, corps of engineers, and the University of Arkansas have actively participated with the U.S. geological survey in these studies.

Hubert chanson [12] hydraulic engineering and roman aqueducts: modern perspectives actas de las IV jornadas de ingeniería del agua 2015. The roman engineering heritage encompasses a number of magnificent structures including bridges, roads, dams and aqueducts, with many still standing. Among these, the aqueducts constitute a fine example of water resource engineering and many aqueduct sections are still in use, in Tunisia, Spain and France for example. Surprisingly, relatively little is known on their engineering design nor the hydraulic knowledge of roman engineers (Hodge 1992, Fabre et al. 2000).

W. James marold e.a. [13] aqueducts, tunnels, canals, pipelines, siphons, and water distribution, USA 2009. Pipelines. These structures may be combined in any manner to carry water for long distances to holding reservoirs or water treatment plants for distribution to the water consumers. The largest aqueduct in the world supplies southern California with nearly 44 m3 s-1 of water carried in open concrete-lined canals from the Colorado River. The aqueducts used to supply water to New York City are tunnels and vary from 53 to 148 km

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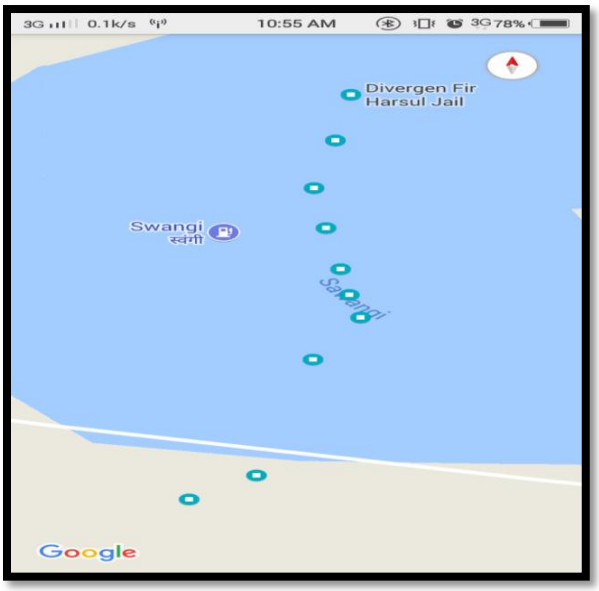
in length. Both systems withdraw water from storage reservoirs formed by large.

Kollipara parvathi manjusha, e.al [14] report no-volume 4, issue 2 | ISSN: 2321-9939,analysis and design of a siphon aqueduct, 2016 ijedr. An aqueduct structure is a complex structure as compared to bridge, as it takes canal water across stream and canal traffic over the trough. The water tightness and free expansions - contractions of trough, canal water load as well as traffic load on the trough involves complex load combinations, for which the superstructure and substructure of it isrequired to be planned and designed.

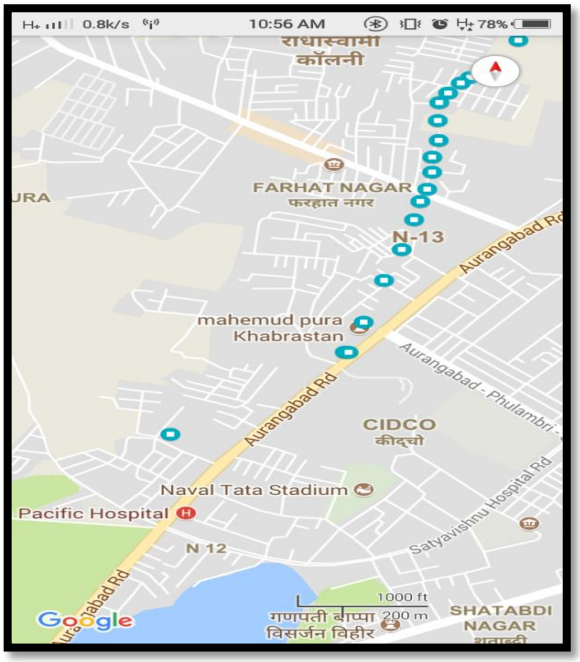
Yawar mushtaqrainae.al [15[report no - EISSN: 2319-1163 | PISSN: 2321-7308, hydraulic design of an aqueduct and its necessity in rajouri town in Jammu and Kashmir, ijret: international journal of research in engineering and technology. Aqueduct is the cross drainage arrangement which make the route of water from one side of drain to the other. Most of therajouri town is hilly and semi-hilly belt. At rajouri about 9000 hectares areas of land remain deprived of irrigation facilities. The main aim of the paper is to present the hydraulic design of aqueduct proposed over Darhali River in rajouri town and explain as to why aqueduct was required in this area. To assist the growth of crops in areas adjoining to Darhali River construction of aqueduct from left bank to right bank of river was projected. Aqueduct of 6 x 9.5m span was proposed to be constructed.

APPROACH METHODOLOGY:

Mapping:Field survey is conducted in this project to locate water towers with the help of GPS: Then with the use of quantum GIS software prepare map for position of water towers & flow of water in aqueduct from start point (SawangiLake, harsool) to end point (Gaimukh,opp.taj hotel).Use GPS. Google map provide our location in x-direction and y-direction.You should also locate the point by fix distance and point step by step and it also give one of the fix distance average to your located point .Till up to located 86 manholes as well as air tower. Neher-e-Ambariproper map still not available up to.Create a rough map of Neher-E-Ambari and after that use QGIS software.



Pic.1 Screen shorts of mapping (GPS)



Pic.2 Screen shorts of mapping (GPS)

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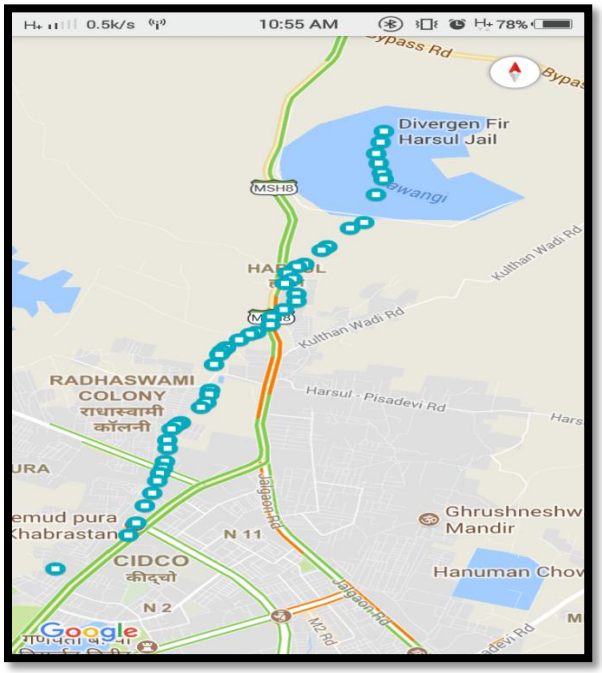

Pic.3 Full Screen shorts of mapping(GPS)

Pic.4.A Water /Air Towers

Pic.4.B Water /Air Towers

Water Sampling Testing:It is the very old system of drinking water near about 350 years. Upto now not conducted any type of water test on this Neher-e-Ambari water so conducting water test on Neher-e-Ambri. Collecting the water sample from Sawangi start point and end Gaimukh in 2 liters quantity within duration of 1 hr and conducting water test inwater resource department lab class-2 Marathwada region, Aurangabad, water sample collecting on dated 1 February 2018. The water testing done in two session one is winter and second is summer because the parameter result changes with respect to session and atmosphericcondition. After two tests in the rainy session third test can also conducted. The test conducting on following parameters,

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Table No.1 Water quality parameters

Sr. No	Parameters	Unit
1	Ph	Mg/l
2	Suspended solids	Mg/l
3	Total dissolved solids	Mg/l
4	Chlorides	Mg/l
5	Total hardness	Mg/l
6	Calcium hardness	Mg/l
7	Total alkalinity	Mg/l
8	Chemical oxygen demand (COD)	Mg/l
9	Biochemical oxygen demand (BOD)	Mg/l
10	Oil and grease	Mg/l
11	MPN	No. / 100 ml
12	Odour	No. / 100 ml
13	E-Coil	Col.
14	B-Coil	Col.

ADVANTAGES:

1.This water supply system is having low maintenance and few types of equipment for working.
2.No need of electricity hence does not produce any type of harmful gases like carbon.
3.It is unique and ideal water supply system which is collected peculated ground water as well as storm water in each place.
4.Construed in locally available material like bricks and lime, etc.
5.Useful for Green revolution to make green and healthy Aurangabad.
6.This is underground water system so it does not affect on valuable land.
7.This is useful for local minor projects.

Study:
1.In this System Three main sources are available,
i.Sawangi lake
ii.Percolated ground water
iii.Strom water(In rainy Session)
2.This system based on gravity and siphontechnique. An underground 2½ km. tunnel was dugout from the bottom of the elevated hills with providing gradual slope in the bottom tunnel towards town.
3.The complete Nahar Aqueduct is built in brick & limes and thousands of cavities are left to enter the sub terrain spring water in the tunnel.
4.At the top of each tower was an open tank of several cubic meters. The purposes of these towers were,
i.To supply water to the higher parts of the town without pressure loss.
ii.To function as an air relief valve to prevent a pressure surge resulting from sudden cessation of the water flow to allow a water outlet for public use and irrigation at several points along the aqueduct without loss of water pressure.

CONCLUSION:

The 350 year old water supply system is working effectively without anymaintenance, without silting and corrosion. The life of present water supply system is 30to 50 years and with maintenance. The methods and materials used for neher system isavailable locally and constructed by local skilled and unskilled labour. This will helpfulto solve water problem in developing countries. Aurangabad is one of the fastest growing cities in theAsia with a population of almost 18 lakhs. The waterconsumptions from industries and civilians is a part andparcel of the city's economical growth. The existingaqueduct system including Nahar e Ambari could helpsolving the water scarcity problem, if properly worked.As the only source of the water supply for this growingtown us Jaikwadi (Nathsagar) dam, we cannot expect it toserve the catchment area for too long. This is where, Nahare Ambari comes into the picture.The natural benefits can be used efficiently as theaqueduct contains a fully gravitational flow, flawlessnetwork of the chambers, properly spaced

outlets, manholesfor the maintenance purpose. Hence the system could servethe city without involving electricity and other traditional resources.

REFERENCES:

1.Boralkar D.B. (2012) bioremediation of sewage disposal in the KhamRiver, at Aurangabad (Maharashtra), project proposal.
2.Dr.Shaikh Ramzan. (2010) .a workbook on 400-years under ground living aqueducts.
3.Dr.P.A.Sadgir and dr. U j kahalekar
(2007). Study on dying wisdom of medieval water.
4.Sheikh Afreen. E.al. Study of aquatic protozoan in Neher-e-Ambari in Aurangabad. (2014).Pradeep Purandaree. E.al. A review on water governance and droughts in Marathwada. (2012).
5.Pratik v. Mane e.al. Engineering aspects of Neher-e-Ambari and its necessity in Aurangabad (Maharashtra), (2017).
6.W. James marold,e.a water storage, transport, and distribution-aqueducts, tunnels, canals, pipelines, siphons, and water distribution.
7.Evan JamesDempsey report no-3116 522 2 the aqueducts of ancient RomeFebruary 2009
8.Jean debouche report no- 48.2 (2013) 207-217, water supply systems of the senji (gingee) fortinsouth India (16-18th century),Indian journal of history of science 2012.
9.S. Krishna Kumar e.al. Report no- apple water science (2015) 5:335–343 doi 10.1007/s13201-014-0196-4. Hydro-geochemistry and application of water quality index (WQI) for groundwater quality assessment, Anna nagar, part of Chennai city, Tamilnadu, India. Published with open access at springerlink.com 2014.
10.R. T. Sniegocki and j. E. Reed report no- 1615-d principles of siphons with respect to the artificial-recharge studies in the Grand Prairie region Arkansas, geological survey water-supply paper1963.
11.Hubert chanson hydraulic engineering and roman aqueducts: modern perspectives actas de las IV jornadas de ingeniería Del agua 2015.
12.W. James marold e.al. aqueducts, tunnels, canals, pipelines, siphons, and water distribution, USA 2009.
13.Kollipara parvathi manjusha, e.al.Report no- volume 4, issue 2 | ISSN: 2321-9939, analysis and design of a siphon aqueduct, 2016 ijedr.
14.Yawar Mushtaq Raina e.al report no - eissn: 2319-1163 | pissn: 2321-7308, hydraulic design of an aqueduct and its necessity in rajouri town in Jammu and Kashmir, ijret: international journal of research in engineering and technology.