

Efficient water management strategies in ancient Pune

Mr. Sudarshan Bodhankar, Associate Professor,

Bharati Vidyapeeth Deemed to be University College of Architecture, Pune India

Email: apsbodh@gmail.com

Abstract - Smooth functioning of any dwelling needs an effective integration of services with architecture. Identification of right method and technique for water supply and management services plays a vital role for successful project implementation. Current stage of Pune city display a few challenges with regards to water supply and treatment. Pune old city is a strong example of efficient water supply channels both for domestic as well as drinking purposes and its supervision during different seasons and conditions. But due to the various redevelopment activities the services of conventional times are being applied ignoring the existing resource. This study attempts to explore the science of ancient water provisions along with proofs and documented photographs. This study will be based on timeline development showing the changes and progress of technology and methodology of delivering sufficient water for each dwelling unit.

Keywords-Water supply, ancient Pune, water channels, river, lake, cannel

I. INTRODUCTION

Water is amongst crucial requirements for survival of living beings. Ground water and surface water are the major resources of water. On the earth, water gets evaporated from huge water resources such as oceans and from vegetation into atmosphere due to the solar heat by transpiration method. The evaporated water particles return to the earth's surface as raindrops in hot areas and as snowfall in colder regions. This restored water is collected in the naturally formed rivers, ponds, lakes or manmade dams which is percolated into the ground by time. This water collected on the surface is preserved and used for the advantageous living animals causing a blessing for survival.

Back in ancient days, the value of water was well known to the people and hence discovered numerous methods to handle and store maximum possible resources. People of that era took proper care of drinking water, domestic water and were concerned to help the cattle animals to have sufficient water for their survival. Agriculture was another task for those people, since constant water supply from the rivers was not possible and satisfactory rainfalls were not very promising and frequency of drought years were more.

This paper covers the concepts relating to rainwater harvesting, flood water harvesting and many more ways of gaining water in old Pune context.

II. BRIEF HISTORY OF PUNE'S WATER SUPPLY

The main and the crucial support of Pune's water supply have always been Mutha rivers. For centuries it has been in existence and till now, the provision is ongoing. Maratha Empire grew in the Pune during 18th century. In year 1750s, when the city of Pune was in the power of Peshwas, Nanasaheb Peshwa constructed a storage lake at Katraj and this was the first water supply source of the city. This water was channelized to fetch water to the prime area of the city-Shaniwar Wada and the surrounding areas tanks, which were known as Hauds. To overcome the annual water crisis, Nanasaheb Peshwa began the construction of a lake at Katraj in year 1749. Water from this lake flowed into a second lake at the lower level that stored an even larger amount of water due to the depth. The upper lake had an eight-feet-long wall, while the lower lake's wall was nearly 1,000 feet long, 40 feet high and 15 feet thick. Few openings were built in the wall, which allowed the water to flow out, were water was plugged. There were separate gates used to clean the residue that settled at the bottom of the lakes. These structures were strong and residue from the built part found even now. When the disaster was caused due to Panshet Floods and both the main dams of the city were damaged, this system was abandoned.

At the end of the 18th century, these Peshwas, particularly Nanasaheb Peshwa added more storage tanks and aqueducts in the city to reroute the water supply for the rest of Pune region.



An early 1900s photographic postcard of a water tank in the city.
Source: OMAR KHAN

The reign of the Pune city came in hand of the Britishers in 1817 and due to their expansion in the east side of the Pune city. English ruler started initiating water supply facilities for their conveniences by building storages in tiny bunds near their societies which is now known as Bund Garden. Then, in year 1867, after indepenence, the Khadakwasla Dam was built. This was planned a small place adjacent to the city, Panshet, the dam was the biggest once till date in the vicinity. The construction of this huge dam was begin in year 1955 and after a prolonged effort of saving the dam from failing through due to cracks and other errors, it was finally completed by the end of year 1961. As a result of this huge structure as obstruction in the flow of river Mula occurred a massive flood which wiped out both the dams the Khadakwasla as well as Panshet. Few instant substitutes were brought into practice for some years to get time for the dams to be fixed. To supply water to the public till the repairing of dam, the ancient Peshwa system was rememorized, Katraj channel was used divert the Mulshi dam water by Mula river. This water was stored in a huge tank called bund near Aundh and the water drawn out from here by the use of pumps for the further use. With the increasing water demand for agriculture within the city and in the outskirts, two more dams were proposed. These dams were named as Varasgaon and Temghar completed in year 1994 and 2000 respectively. Meanwhile, Pawana dam was built in year 1990 and this was the main source of water demand for PCMC (Pimpri-Chinchwad Municipal Corporation) area.

2000	Temghar dam was completed
------	---------------------------

Chronological history of water supply in Pune

III. ANCIENT WATER STRATEGIES OF PUNE TO SUFFICE DOMESTIC PURPOSE:

People of ancient times were quite aware and respectful towards water resources. They implemented various strategies to organize and store water and the valuable reservoirs. The historic Singhagad, well known fort of the city is facilitated with several different sized tanks within the premises. These tanks are formed during the construction of the fort, to develop the habitable spaces in the hills; the hard rocks are dug from the hill. The hard surface when mined to get stones to form walls, created the pits. The hollow trenches crafted in this manner formed the tanks in the fort. These containers are used to store rainwater and use it in non monsoon season. In total there are about 48 such rock-cut basins (Retained till now) in the fort with different specifications few being closed under the rock or slops while other open to sky. It is said that to increase the height of the tanks, at time the masonry walls were build around the naturally formed once. At times, to capture the runoff rainwater from the surfaces, tanks were planned and constructed in groups so as to aid the maximum water to be recharged and accumulate the most of it for the occupants of the fort.



Rock-cut water cistern with dressed stone walls at Sinhgad fort.
(Source: India Water Portal)



Dev take at Sinhgad fort. (Source: India Water Portal)

Chronological history of water supply in Pune

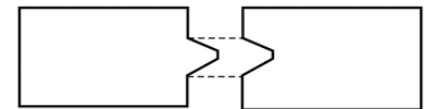
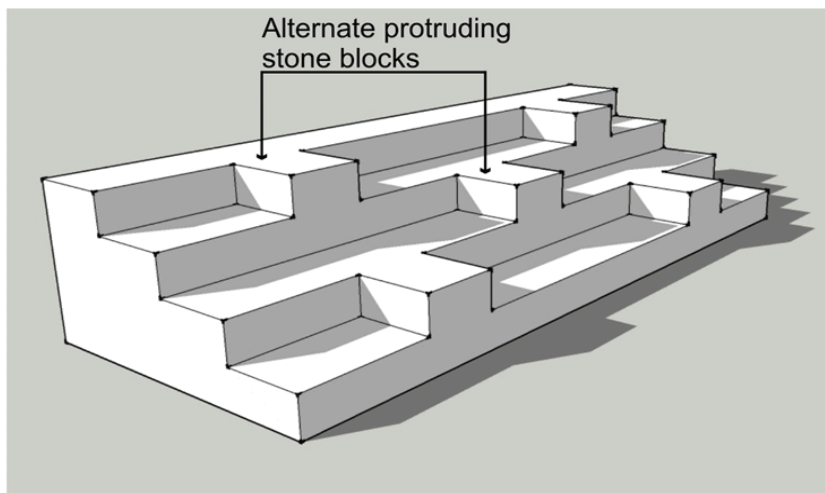
1750	Establishment of Katraj Lake
1788	Enroute water supply to Rasta Peth
1790	Water through earthen duct was provided to sadashivpeth, shukrawarpeth& Bhavani Peth
1848	Bunds was created for water retension and to supply water to pune cantonment.
1860	Khadakwasla dam was built
1876	Small canals were established parallel to Mutha River.
1890	Pashan Dam was built
1955	Panshet Dam was built
1994	Varasgaon Dam was completed

Once the construction of the fort was completed, the post development engineering was done to enhance the water supply within the fort. In Sinhagad fort, a special technique was practiced to generate the ground water springs by creating artificial blast in the dug pits. This blast caused the underground cracks to form the way for the water to flow.

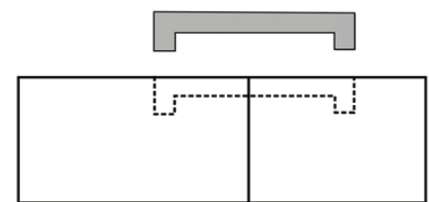
Another fort in the vicinity of Pune core city, Rajgad, also known a fort was never approached by any any other kingdom than that of Marathas. This is one of the greatest pieces of architecture with largest provision of water storage within the huge hill. The ministers of Rajgad valued the water resources more than any other services as the hill was too steep and it was difficult to get any water from the ground level. Owing to this concern, they made efforts to build two huge lakes also called as Talaavs in local language and about 39 rock-cut containers that can be found even today in the fort.

Many experts and ministers which were then known as panades were called for finding out the water sources at that time. Many springs were found which extracted from the rocks and were exposed out. One of such spring was Chandra Lake located in the Rajgad fort. This fort had a unique characteristic of gradual slope which made it effective for constructing lakes. Right now, 12 lakes can be found in this fort. Another unique lake constructed on the Rajgad fort is Gangasagar Lake which has the highest storage capacity.

The history of water supply to the common man or any individual in the history of Maharashtra has a unique essence. All the forts carried out the same water supply system. Also, the common people were allotted water according to their administrative post and the water was to be carried out manually by water carriers known as Panke who were paid according to the water load they have carried out.



Tongue and groove joint



Clamp joint



Sketches showing step profile and joinery. Source: Author. Manas Marathe

According to the study by Marathe, M. (2021) 'another ancient water management technique of the construction of Kunds or bigger lakes known as Baravas' which were like descended platforms from top to bottom was noted. The shape may be square, oblong or sometimes octagonal and was distinct due to the groundwater level. The catchment area of these systems were more like a reservoir which were buffered by the lines of decreasing steps to make the water level rise to the top. Nowadays, this construction gets confused with the making of water tanks (2016).

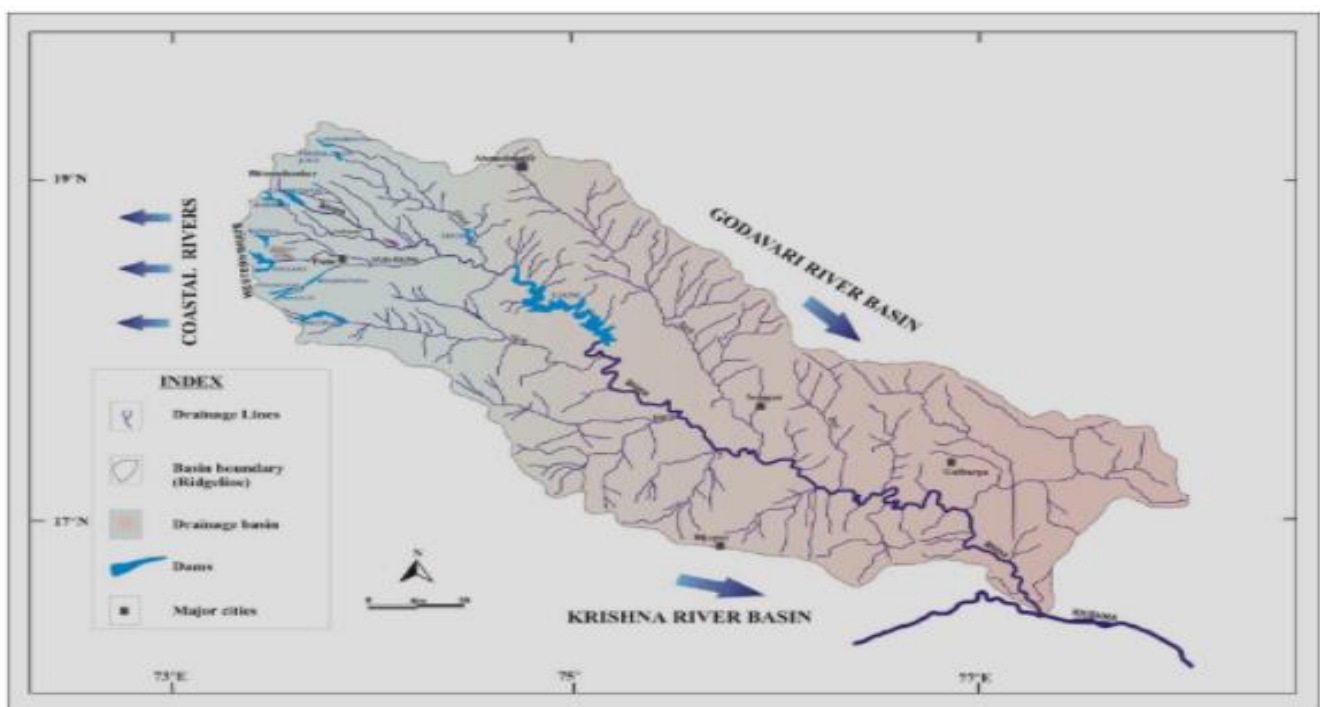
1. CANAL SYSTEMS DEvised IN THE 18TH CENTURY



The pioneer man of that time, Nanasaheb Peshwa devised canal system in a manner of an underground tunnel built which connected two main lakes for supply water into the main city. This tunnel trespassed to the Sarasbaug area and supplied water there to the rest of the city. Then, it was supplied to public tanks and households which finally was lined to Shaniwarwada. The characteristic of this tunnel was its gradual slope as the height of Katraj Lake was 723 metres, and it reached the low of about 540 metres above sea level at Shaniwarwada. This system was used till the 20th century and flourished well for many households. Some of the existing tanks which are working well are Kala Howd, Budhwarm Howd, Phadke Howd, Badami. One of the Dams near Ambil canal was built to the west of Shaniwarwada, and which diverted water to the Lakdi Bridge. Another tank at the foothills of Parvati Hills was also built which was used for recreation, with steps leading to the water from the Hirabaug Palace.

Map showing the aqueduct line and network from Katraj Lake to the Peth areas;

MAP GRAPHIC: PALLAVEE GOKHALE



Detailed map showing the aqueduct line and network from Katraj Lake to the Peth areas; MAP GRAPHIC: PALLAVEE GOKHALE

2. EXAMPLE OF ANOTHER ANCIENT SUSTAINABLE WATER SUPPLY SYSTEM- PANCHAKKI AURANGABAD

Maharashtra has always been blessed with its well groomed topography and beneficial for its water outlets. One such city, Aurangabad has a historical water mill known as Panchakki which has its own underground channel which has a characteristic of generating energy from water flowing and using this to grind large stone of the flour mill. This unique system is an attraction for this city and till date, the water is sourced in clay pipes to the north of the city supplying it to the rest of the town. This 17th century mill which is situated at a distance of 1 km from the main city source water from the mountains and channelized it to the artificial waterfall that powers its generation.



Panchakki of Aurangabad – Ancient Watermill

By Satish, India Maharashtra



The large Grinder of stone to grind the floor

Panchakki, Aurangabad – An Engineering Marvel

3. MODERN WATER STRATEGIES OF PUNE

Pune Municipal Corporation regulates the water supply of Pune city. Surface water source is regulated by the respective municipal corporation of Pimpri chinchwad, Pune. Groundwater sources are regulated by the government bodies like PMC and PCMC, Maharashtra state Water Resources and Regulatory Authority also known as MWRRA is functioning as the Authority of

State Groundwater and Survey of Groundwater and Development Agency also known as GSDA.

Pune receives a good amount of annual rainfall. But the Government has to supply drinking. Water supply as well as sewerage services along with rain water drain system in the city of Pune and the Taluka areas are under provenance of Municipal Corporation of Pune and in extended area of Pune, Pimpri Chinchwad region and the Taluka area are under Municipal Corporation Pimpri-chinchwad respectively. Surface water managing similar to local ponds and lakes, in these areas are taken care by the relevant municipal corporations. The modern water managements have been enforced by these government bodies to make the water management systems more efficient than before. One of the implemented rule by the new DCR - Development Control Rules, states that the groundwater recharge via rainwater harvesting must be incorporated within Buildings sanctioning Department of PCMC as well as PMC. All the plot areas of more than 300 sq.m should be mandated with this system. At present various water management projects have been projected by the corporation Various projects owned by the Pune municipal corporation like instalment of proper sewage treatment plants, JICA MulaMutha Pollution Abatement, Storm Water management systems, 24* 7 water conservation.

4. CHANGING SHARES OF SURFACE WATER AND GROUNDWATER IN PUNE

Due to the geographical condition and the natural water outlets, Pune has been blessed with abundant water resources. But, as new technologies are coming with the growing population, water scarcity in summers can be felt. This is because of the use of groundwater resources despite using its main water asset from Khadakwasla dam. Therefore, it restricts Proper understanding and management of the availability of the water resources. Many areas of Pune are dependent on groundwater systems mostly the per-urban areas such as Aundh, Baner, Pashan, Sinhagad road, Wadgaonsheri and Dhayari.

But still the water resources are the boon for the pune city. Various Aquifers are found in the pune regions which have a capacity of Vesicular formations giving a strong point for water holding capacity which depends on its intensity of weathering, fracturing and jointing. Borewells can be effectively charged from these aquifers. There are five aquifers exposed out of a topographical profile of 250metres.

5. SUSTAINABILITY OF WATER RESOURCES AND ITS BLUEPRINT IN PUNE

Pune city is situated in a hydro geological zone with heterogeneity as well as anisotropy which determines aquifer qualities like proper groundwater, sediment and evaporations. Here the key task is to calculate and

determine the quantity of groundwater that can be extracted per year.

This city has excellent geographical features with ample of water available through various resources. Two major fresh water sources are embraced within the boundaries of the city one is Mula, the tributary of river Mula and the other is river Mutha. Bhima river, a major part of great giver Krishna, shares its lower basin with the city. There are about twenty four permanent and eleven seasonal springs, which are quite phenomenal in this city. An area in the city named as Bavdhan, a village with several small and large wells has 2 streams providing water to Ramnandi River. Initially, this village has many wells in use, but since few decades the villagers have started using the water directly from the streams for their daily domestic needs. Now a days due to scarcity of space for construction, these springs are been closed at certain areas. It is predicted that someday these springs might vanish under constructed areas. The local bodies try to retain the flow of these springs by clearing the garbage scattered by the villagers around the water body. A research was conducted by a hydro geologist who studied on Central Ground Water Board, Pune. Upendra Dhonde in his conclusion about the springs of Bavdhan village and the surroundings highlighted the following points.

- Maintain the water quality by keeping the catchment areas cleaner and away from garbage dumps
- Increase the green area around the catchment areas so as to reduce the soil erosion
- To recharge the aquifer, enhance the conventional in access of water in the springs
- Avoid polluting the water bodies both ground water as well as surface water by regular cleaning of runoff channels
- Spring water should be collected in an manmade tanks and wells to control the runoff
- Spread awareness regarding the management and monitoring of these natural springs to save the springs from disappearing due to human developments
- As like river front development and aesg. improvement, the springs should be given sj importance by increasing activities around the spring basins.

6. CURRENT FOUND FRESH WATER STREAM IN PUNE:

A water tank (*howd*) is found near Shaniwarwada recently, while digging the ground for drainage service pipeline (Sakal Paper news). This Fresh water stream is 325 years old. During the marking of by drainage lines, municipal

worker team found the steps going downwards. Further digging showed that the way goes to a tank. This tank was connected with a fresh water stream. Historian Mr. Mandar lavate said, this tank was built by Nanasaheb Peshve in year 1749 AD during the time when the two lakes were formed in Katraj Surrounding. The water from these two lakes was supplied throughout the city. It is predicted that this stream of water was a part of that system. The British government used the same system till year 1920. After this year the system was changed.

7. CONCLUSIONS

Pune city includes an excellent ancient water supply system that was devised considering all aspects for water management including rain water harvesting, wate supply with regards to the ground water and the seasonal changes anticipated in ground water levels. Further, the drainage system was in line with this system and had a systematic disposal way. With today's development we are losing the essence of this existing resource and moving towards the temporary and unstable means for water management. We should take the technology support from the ancient system and try to integrate the logics to the newer systems creating much more sustainable approach to water management aspect.

REFERENCES

1. Chavan, V. (2019). Ancient methods to save water revived. Pune Mirror .
2. Gupta, D. (2016). Urban planning at Bundi: Subterranean Water Structures. Water design: Environment and histories , 32-47.
3. Himanshu Kulkarni, M. R. (August 2019). PUNE'S AQUIFERS Some Early Insights From A Strategic Hydrogeological Appraisal.
4. Jacob, N. (2011). Jalyatra: Exploring India's traditional water management systems. India Waterportal .
5. Mane A. V., P. R. (2013). Water quality and sediment analysis at selected locations of Pavana river of Pune district, Maharashtra . Journal of Chemical and Pharmaceutical Research .
6. Marathe, M. (2021). Bāravas: An Architectural Exploration of the Traditional Groundwater Storage Structures of Pune, India. Ancient Asia Journal of the society of South Asian Archeology , 3-5.
7. Sidawi, B. (n.d.). A conceptual analytic model of the vocabulary of the Islamic Architectural Haritage. Emirates Journal for Engineering Research , 2011.

Sakal Paper, Tank found from Peshve Era, Pune TA, 30. Pune, Saturday, 1st May 2021.