International Journal for Research in Engineering Application & Management (IJREAM)
ISSN : 2454-9150 Vol-08, Issue-02, MAY 2022

Water Demand Assessment: A case study of Cantonment area Agra

[1]Rajat Diwakar, [2]Raghvendra Singh, [3]Kamini Yadav, [4]Shivam Dhakre, [5]Devesh Jaysawal

[1,2,3,4]B.tech Student, [5]Assistant Professor, Dayalbagh Educational Institute Agra, Uttar Pradesh, India, [1]rajatdiwakar4999@gmail.com, [2]raghvendrasingh15072002@gmail.com, [3]kaminiyadav385@gmail.com, [4]shivam00556@gmail.com, [5]deveshjaysawal@dei.ac.in

Abstract----Water is the lifeline for nature and human. Water is the first essential thing that human need. Scarcity of potable water is a big problem in Agra region because ground water of Agra is not drinkable due to excess hardness and saline taste and Yamuna river which is flowing through Agra is heavenly polluted. Ganga Jal supply is a big project launched in 2020 which has been corrected this deficiency on a large extent. In Ganga jal project Ganga river water is bringing 140 cusecs to Agra which helps to meet the drinking water demands in the city. Still many areas of Agra are not connected with Ganga Jal water distribution system and cantonment premises are one of them. So scope of my research is potable water supply management system for a small part of Agra city (Cantonment and Defence area). In this project we connect our water supply system to the water works treatment plant unit whose capacity 125.9 MLD which can also be increase to up to 225.9 MLD:

Keywords---- INTZE tank, L/H/D, MLD, per capita demand, water treatment plant.

I. INTRODUCTION

Nowadays, water utilities of water supply systems in Agra are facing a great challenge to supply water due to technical and economic reasons. We need to increase the capacity of existing water treatment plant and their performance of the whole system, because of the scarcity of water resources in many regions in Agra. The water supply system in most Agra has less water supply who does not full fill the requirement of water of each zone of Agra. Losses due to leaks and ruptures that result from the inevitable advanced age infrastructure, concepts and constructs deficient or inadequate operation and maintenance.

II. OBJECTIVE

The overall objective of this study is to supply water in whole Agra city. In our research we find the water stressed region where water is depleting day by day and quality of water is also decreased. According to survey work done by me, we take one location in Agra city where water is depleting and in four-to-six-year ground water is completely lost.

i. To supply clean water to the end user.

ii. Find the various methods to provide water according to site condition in Agra city Final Stage

III. FIELD OBSERVATION

Real time water demand assessment is as follows:

- Source Of Water
- Population in water stressed area.
- Water Required For A Particular Area?
- What Is the Capacity Of Pump Is Required?
- What Is the Pressure Required In Pipeline?
- What Is the Diameter Of Pipes Is Required?
- Project Cost Estimation.

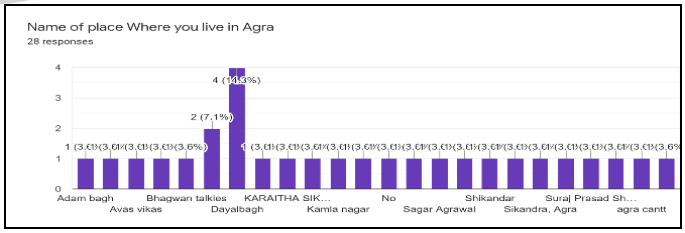

Fig 1(a) place of surveys

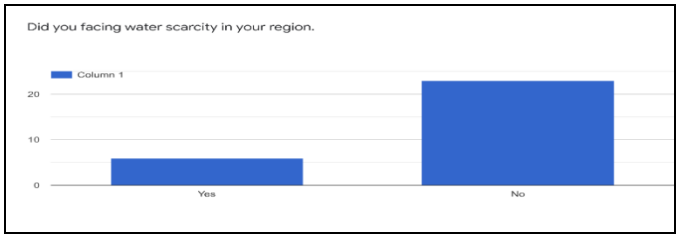

Fig 1(b) water scarcity graph

 DOI : 10.35291/2454-9150.2022.0211

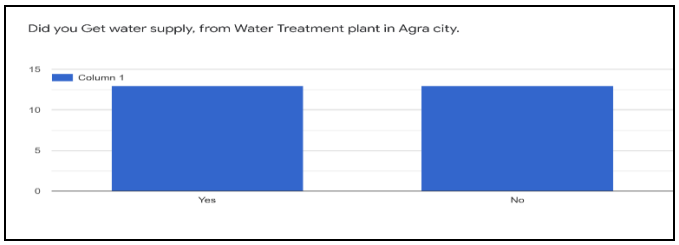

Fig 1(c) water supply by WTP.

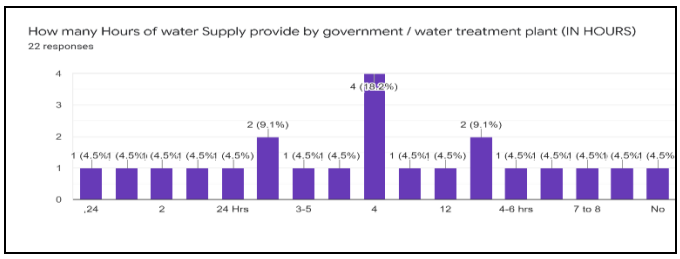

Fig 1(d) Hourly supply on different location by plant

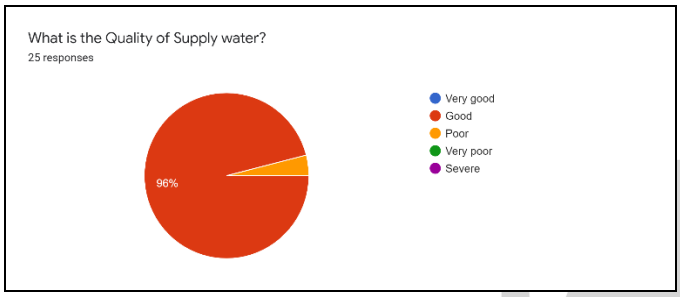

Fig 1 (e) Quality of supply water

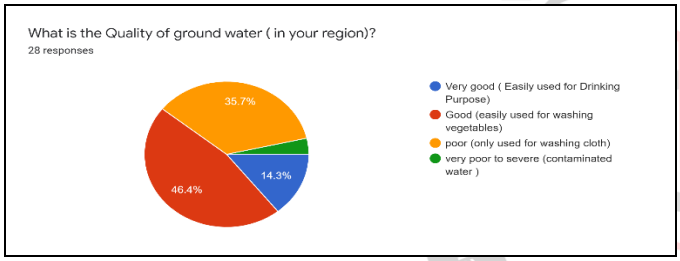

Fig 1(f) Quality of Ground Water

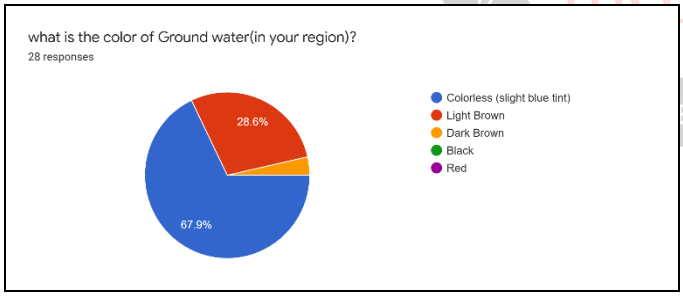

Fig 1(g) Colour of ground water

Fig.2 *Location of water works*

Area of water stressed region: 27.59 km^2 perimeter 40.69 km.

Distance from defense Agra cantonment to water works is 15.4 km.

How Much People Lives In Water Stressed Area?

In Agra district **10,000** inhabitants per square kilometre

= 27.59 x 10000 = **2,75,900 people**

Water Requirement Of 2,75,900 Peoples

= 275900 x 135 = 3,72,46,500 litre = 37246.5 m3

so we need 37,246.5 m^3 of water daily.

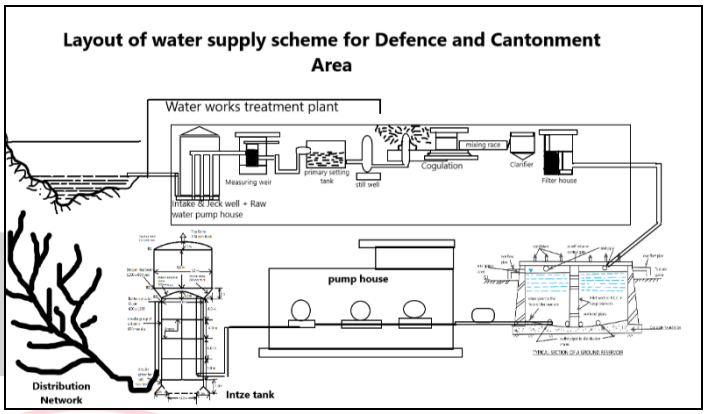

Fig.3 Layout of water supply system

Fig.4 Water stress area

IV. METHODOLOGY

i. Designing of reservoir

Surface Reservoir store the treated water which is coming from water works water treatment plant. Water stored in reservoir supplying water during emergencies (such as during fires, break-downs, repairs, etc.) and also to help in absorbing the hourly fluctuations in the normal water demand. It helps pumps to operate at a constant speed and maintaining constant pressure.

Capacity of reservoir = 50,000 m3

No of reservoir = 2

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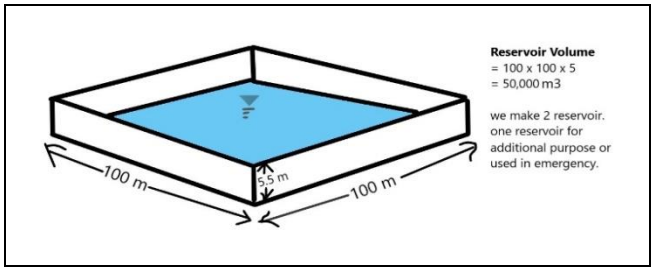

Fig. 5 capacity of reservoir

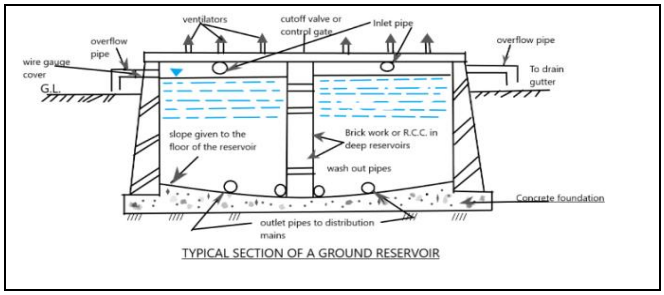

Fig.6 Design of reservoir

Elevated Reservoirs are the rectangular, circular, or elliptical overhead tank erected at a certain suitable elevation above the ground level and supported on towers.

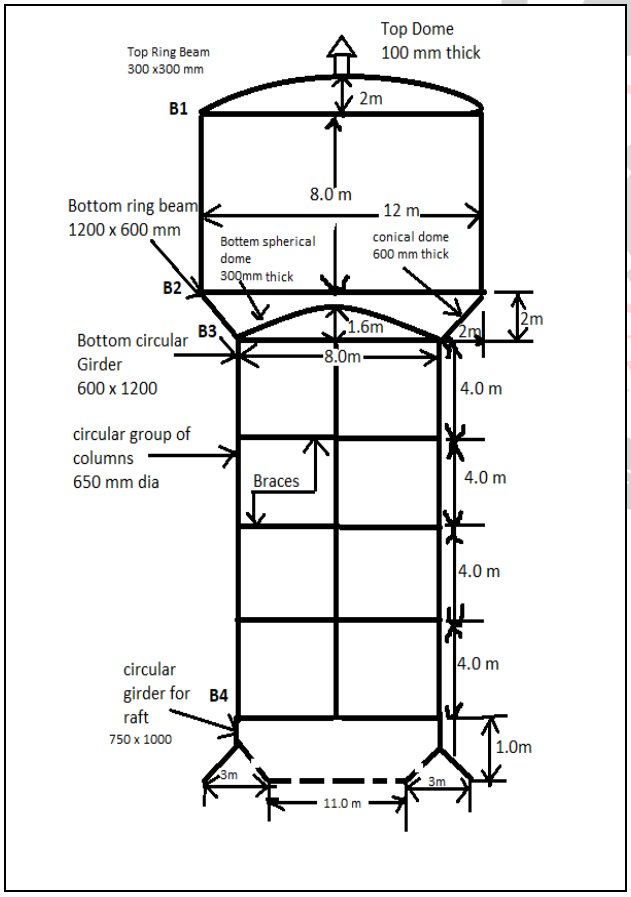

Fig.7 Design of INTZE tank

DESIGN OF INTZE WATER TANK

Capacity = 1000 m^3

Height of tank = 16m

Height of dome = 12 m

Number of column = 8

Population of Agra

- According to census of agra district the population is 44,18,797.
- Area of Agra 10,863 Sq. Km.

No	Name of work			
1	Tank capacity	1000000 Ltr.	1000m3	
2	Height of tower from G.L.	16.0m	Foundation from G.L.	1.0 m
3	Live load on Dome	1.5 kn/m2	Finish load	0.1 kN/m3
4	Intensity of wind	1.5 kn/m2	Wt. of water	10 kN/m3
5	No. of columns	8 No.	Bearing capacity of pear	250 kN/m3
6	Concreate	M20	Unit weight	24 KN/m3
	∑ cc	5 N/mm2	m	13
	∑ cb	7 N/mm2	Q	0.897
7	Steel HYSD (Fy)	415	Tensile stress (tank)	150 N/mm2
	Resistance to cracking ∑ ct	1.2 N/mm2	∑cb	1.7 N/mm2
8	Nominal Cover	25mm	Effective cover	40 mm
9	Depth/ diameter Ratio	1:0.75	Spacing of Bracing	4.0 m

- Variations In Per Capita Demand (Q) With Population In India

Sr. no.	Population	Per Capita Demand in Litre/day/person.
1	Less than 20,000	110
2	20,000 – 50,000	110 – 150
3	**50,000 – 2 lakhs**	**150 – 240**
4	2 lakh – 5 lakhs	240 – 275
5	5 lakh – 10 lakhs	275 – 335
6	Over 10 lakhs	335 – 360

- Minimum domestic water consumption (annual Average) for weaker section and lig colonies in small Indian towns and cities as per is:1172-1993

Use	Consumption in (l/h/d)
Drinking	5
Cooking	5
Bathing	55
Washing of clothes	20
Washing of utensils	10
Washing and cleaning of houses	10
Flushing of water closets, etc.	30
TOTAL	135

Demand for public uses- 5% of the total consumption of water

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It includes the watering of public parks, gardening, washing and sprinkling on roads, use in public fountains, etc.

$= \frac{37246.5 * 5}{100} = 1{,}862.325\ m3$

Fire demand : cities having populations exceeding 50,000 the water required in kilo liter computed by using the relation.

Kilo litre of water required = 100 √p = 100 √275.9

= 1,661 m^3 optional.

where P = Population in thousand

Water required to compensate losses in theft and wastes

Taken as to be high as max 15% of total consumption

We 7.5 % so it is 2793.48 m^3 loss of water.

Capacity of pump required

We have a population of 2,75,900 people in our water stressed area

We design system for 2 lakh people.

Population = 2 lakh

Per Capita Demand 150 L/day/person.

Average Daily Demand = 200000 x 150

= 30 million litre /day

= 3000 m3

Maximum Daily Demand = 1.5 Times The Average Daily Demand

= 1.5 x 30 = 45 mld

Since the pump have to work for 12 hours a day the capacity of pump should be designed for a daily demand.

= 45 x (24/12) = 90 mld

discharge required per second

Q = 90 x 10^6 / 1000 x 24 x 60 x 60

Q = 1.0416 m3/sec.

Required Velocity Through Pipe Is = 3 M/ Sec

Area Required = Q/ V

= 1.0416 / 3 = 0.3472 M2

Diameter Of Main Required = √(0.3472 X 4)/ л

= 0.6649 M = Say 0.67 M

Total Lift Including Suction And Delivery

= 16 + 5

Head Loss Due To Friction In Pipe

$= \frac{4 f l v2}{2gd}$

$= \frac{4 * 0.0075 * 500 * 3^2}{2 * 9.81 * 0.67}$

= 10.269 M

Where L = 500 M

V = 3 M/S

D = 0.67 M

Total lift against which pump has to work

= 16 + 5 + 10.269 = 31.27 m

Brake horse power of pump $= \frac{Yw \cdot Q \cdot H}{\eta * 0.735}$

= (9.81 x 1.0416 x 31.26975)/ (0.8 x 0.73

= **543.396 HP**

V. Conclusion

By the help of this case study we can resolve the problem of water stressed region (Cantonment and Defence Area).

On the behalf of this case study. We found the estimated population of this region and their water demand. In this study we proposed the method that how we provide the water to region which is not having Yamuna river water and Ganga Jal project water. We also find the capacity of pumps which is required to pump the sufficient amount of water to the INTZE Water tank.

In this case study we also done a small survey of different location in Agra city to find the quality of ground and supply water (if provided).

At the end I would like to say that use water responsibly.

VI. Acknowledgement

I express my deep sense of gratitude to **Mr. Devesh Jaysawal,** Assistant Professor, Department of Civil Engineering, Dayalbagh Educational Institute, Agra for his invaluable help. I am highly thankful to him for his continuous support and encouragement in completing this work.

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BIOGRAPHIES

Mr. Rajat Diwakar, pursuing B. tech in Civil Engineering from Dayalbagh Educational Institute (D.E.I.) Agra. He is interested in Water supply Engineering and work as a project intern in JSW Energy Ltd for a training period of 5-month. He is completed numerous projects on institute and during internship. It has good command in AutoCAD and Staad pro. He is currently receive an offer latter from PNC Infratech Ltd.

Mr. Raghvendra Singh, Civil Engineering student at Dayalbagh Educational Institute Agra, Uttar Pradesh, India. He has completed his internship in NBCC (INDIA) LIMITED. He is currently receive an offer latter from Sivanssh Infrastructure Development Pvt. Ltd.

Ms. Kamini Yadav, pursuing B. tech in Civil Engineering from Dayalbagh Educational Institute. She is fascinated about working with Construction management & field work of Civil Engineering. In her 3rd year she had done a 5-month Training from Jawaharlal Nehru Technological University, Hyderabad in understanding about different concepts about Geospatial Technologies. She is further willing to pursue her career in Civil Engineering.

Mr. Shivam Dhakre, Civil Engineering student at Dayalbagh Educational Institute Agra, Uttar Pradesh, India. He is interested in Transportation Engineering. Also, he completed his 5-month internship at NBCC (INDIA) LIMITED, New Delhi. He is currently receive an offer latter from PNC Infratech Ltd.

Mr. Devesh Jaysawal, obtained his M.Tech in Transportation Engineering from NIT Patna in 2014 and graduate in Civil Engineering. Currently he is working as Assistant Professor in Civil Engineering Department in the Dayalbagh Educational Institute Agra, Uttar Pradesh, India.

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 DOI : 10.35291/2454-9150.2022.0211