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ANALYSIS AND IMPROVEMENT OF THE CONSTRUCTION COMPONENT OF AKKALKOT CITY WATER SUPPLY MANAGEMENT.

Sameer Kale, Student of Civil Engineering. Dept. of Master's in Construction Management, TSSM's Padmabhooshan Vasantdada Patil Institute of Technology, Bavdhan, Pune.
Email- kalesameer288@gmail.com
Dr. K.B.Gurani, Assistant Professor, Dept. of Civil Engineering, TSSM's Padmabhooshan Vasantdada Patil Institute of Technology, Bavdhan, Pune-411021.
Email- kvgurani@gmail.com
Prof. V.O. Biradar, P.G. Coordinator, Dept. of Civil Engineering, TSSM's Padmabhooshan Vasantdada Patil Institute of Technology, Bavdhan, Pune-411021
Dr. D.B. Jasutkar, Head of The Department, Dept. of Civil Engineering, TSSM's Padmabhooshan Vasantdada Patil Institute of Technology, Bavdhan, Pune-411021

ABSTRACT:
The demand for potable water is growing in urban settlements and hence, a reliable and efficient drinking water supply system has become essential. Akkalkot being a small religious town; the study concludes a detailed strategy for augmentation and revival of the drinking water supply system by including advanced technological interventions for equitable sustainable water distribution. Some of the key measures are the up-gradation of infrastructure, incorporation of smart water management technologies, and improvement in water quality and distribution efficiency.
Keywords: Water Supply, Scheme Augmentation, Smart Water Management, SCADA, Sustainable Water Distribution, Automatic Meter Reading.

INTRODUCTION:

Akkalkot is a Municipal Council in Akkalkot Taluka of Solapur District of Maharashtra State, India. It belongs to Paschim Maharashtra region in Pune Division. It is located 40 KM towards East from District headquarters Solapur. As per provisional reports of Census India, Akkalkot has a total population of 40,103 peoples, out of which male population is 20,051while female population is 20,052. has been challenged with providing a seamless and quality water to its citizen. Town's existing water infrastructure, mainly sourcing and dependent on Kurnur Dam, is not enough to meet the town's growing demand. With this project, raw and pure water rising mains will be enhanced, water treatment facilities upgraded and smart systems introduced to bridge the gap between supply and demand.

OBJECTIVE:

The project report "Analysis and Improvement of The Construction Component of Akkalkot City Water Supply Management" aims to provide a comprehensive solution to the challenges faced by Akkalkot Municipal Council in delivering a continuous water supply to its residents. The key objectives of the project are outlined as follows:

- Ensuring Adequate Water Supply and Infrastructure Enhancement
- Optimizing Water Distribution and Network Management
- Reducing Non-Revenue Water (NRW)
- Implementing Smart Water Management Technologies
- Promoting Long-Term Sustainability and Resilience

The overarching objective of the project is to present a detailed and actionable plan for the Analysis and Improvement of The Construction Component of the drinking water supply system in Akkalkot

Municipal Council. By implementing the proposed solutions, the aim is to ensure an uninterrupted, high-quality water supply that meets the current and future needs of Akkalkot's residents.

PROBLEM STATEMENT:

- According to the Existing Scenario the Allocated water for the Akkalkot town is only 4.5 MLD but, in the present year (2025) as per the demand calculation overall required demand is 9.22 MLD.
- The growing demand in the town necessitates upgrading the connecting pipe between the jack well and intake well. The existing diameter of 350 mm is inadequate, requiring an increase to 700 mm as per design specifications. Additionally, the current raw water pumping machinery and rising main are insufficient to meet the demand, warranting the proposal of new rising main.
- Also, the extra additional WTP of 6 MLD is required, as the Existing 7.2 MLD WTP is not sufficient to Fulfil required water demand. Thus, quantity as well as quality of drinking water is the major issue obstructing the development and growth of the town. To supply adequate and safe drinking water.
- As per the current scenario total distribution is supplies by using Existing ESRs & GSRs. Due to these the water supply system of town is facing several problems at present. A low per capita water supply rate, short hours of supply, insufficient terminal pressure in the outlying areas, and non-uniform water supply rate are the major problems. Most of the colonies do not receive municipal water supply. Distribution network is present in few areas is good in condition.
- The existing distribution network was established a long time ago of about 35 years old & total 90 % distribution area is covered by the old pipe line network. These distribution lines consist of varying materials, including PVC with a pressure rating of 4 Kg/Cm² and HDPE with a pressure rating of 6 Kg/Cm².
- However, it is important to note that while the existing distribution pipeline is PVC 4 Kg/Cm², the recommended grade according to Amrut Guidelines is 6 Kg/Cm².
- Presently, out of the total existing network, 1166 meters of HDPE and 8500 meters of PVC are deemed to be in good condition.
- Additionally, there have been no extensions of pipeline networks into newly developed areas yet. There is no defined zoning of distribution system.
- The current households of Akkalkot town are 11557 No’s & it is not provided with proper AMR meters. So, there is need to provide the Household connection with Scada operating AMR Meters.

METHODOLOGY :

The current situation was evaluated and an augmentation strategy was devised by combining field surveys, stakeholder consultations, and hydraulic modelling. The approach consisted of the following steps:

- Information Gathering: Projections on population, water demand, and infrastructural development were made.
- Hydraulic Modelling: A model of the network was run in order to determine the optimal distribution and pressure zones.
- Technological Integration: AMR meters, remote SCADA monitoring, and smart leak detection were incorporated.

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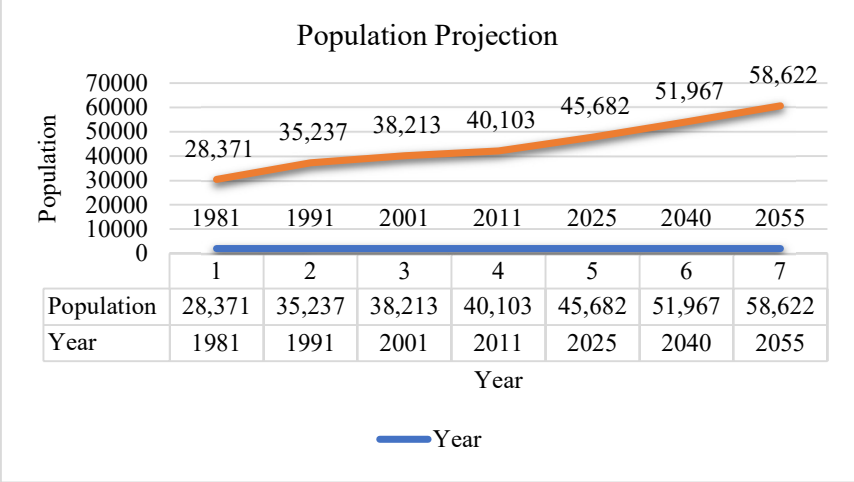
- Execution Strategy: The critical piecemeal development approach was adopted alongside infrastructure provision to achieve AMRUT 2.0.



	1	2	3	4	5	6	7
Population	28,371	35,237	38,213	40,103	45,682	51,967	58,622
Year	1981	1991	2001	2011	2025	2040	2055

Fig. 1 Population Projection

Table-1 Water Demand Calculations

Existing Scheme Details

Year	Projected Population	Rate of water supply in LPCD	Net Demand In MLD	Institutional Net + Floating Net in MLD	Total Net Demand in MLD	Gross Demand in MLD With 15% Losses
2025	45,682	135	6.167	1.674	7.841	9.225
2040	51,967	135	7.016	1.674	8.690	10.224
2055	58,622	135	7.914	1.674	9.588	11.280

The existing water supply scheme of Akkalkot Municipal Council uses a WTP of 7.2 MLD capacity. The statistics of the population show that the population is growing rapidly. The current water supply system is not enough to meet the water needs of the city that is developing rapidly.

Table-2 Existing Scheme details

Sr. No.	Existing Components	Details Of Existing Components	Remarks/Condition
1	Source	• Kurnur Dam • Earthen Cum Masonry Dam • Capacity-23.294 M. Cum. • Catchment area-1254 Sq. km • Controlling Levels- • Top of Dam R.L-462.200 m	Sustainable Source

		• M.W.L./H.F. L- 460.100 m • F.R.L-459.100 m • River Bed RL-447.00 m	
2	Intake well	Dia.-3.0 m (Circular)	Good Condition
3	Connecting pipe	D- 350 mm DI-K9 (2 no's), L-72 m	Good Condition but, Diameter is insufficient to fulfilling the Futuristic Demand
4	Ex. Jack well & Pump House	Dia.-8.0 m (Circular in RCC), Depth-20 m	Good Condition
5	Raw Water Pumping Machinery	V. T. Pump – 120 BHP (1W+1S), Q-75 LPS	The pump is outdated, and one pump is Not Working.
6	Raw Water Rising Main	D-350 mm Dia. DI-K9, L-12500 m	Diameter is insufficient to fulfilling the Futuristic Demand
7	Water Treatment Plant	WTP- Capcity-7.2 MLD	Good Condition
8	Pure Water Gravity Main	D- 250,350 mm & 400 mm DI - K7, L-3370 m	Good Condition
9	Pure Water Pumping Machinery	C.F Pumps-10 HP & 5 HP	Not Sufficient to Fulfilling the demand
10	Storage Structures	Existing GSR- 3 No's Existing ESR- 3 No's Under Construction ESR- 5 No's	Good In Condition
11	Existing Distribution Network	Total Ex. Distribution Network is 25 Km in length	Out of the total network 8500 m of PVC 4 Kg/ Cm^2 & 1166 m of HDPE 6 Kg/ Cm^2 is in good condition.

PROPOSED SCHEME:

The proposed Urban Water Supply Scheme at Akkalkot Town, aims to enhance the existing infrastructure and meet future demand. The scheme includes constructing a new 6.0 MLD Water Treatment Plant adjacent to the existing 7.2 MLD WTP, increasing the total treatment capacity to 12.0

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MLD. Raw water will be sourced from the Kurnur Dam through an existing jack well and pumped to the WTP using 350 mm dia. DI-K9 rising mains.

The scheme involves the Under construction Elevated Service Reservoirs (ESRs) and a Master Balancing Reservoir (MBR) for efficient storage and distribution. Key storage capacities include a 14.0 lakh liter MBR, a 10.0 lakh liter GSR, and ESRs ranging from 2.0 lakh liters to 5.0 lakh liters with a staging height of 12 m. The distribution network will cover 78,007 meters using HDPE and DI pipes of varying diameters (110 mm to 350 mm).

Head Work Arrangement: The Existing intake arrangement is located on the bank of the Kurnur Dam. It consists of the following sub works:

- Existing Intake Well: - Existing R.C.C. Intake well in Kurnur Dam. The bottom level is 446.10m.
- Proposed Connecting Pipe: - Proposed Connecting pipe of diameter 700 mm dia. DI K7 pipeline of length 75 m to convey water from intake well to Jack Well.
- Existing Jack Well and Pump House: - Existing R.C.C. Jack well of Diameter 8 m and Existing overhead Pump House.

Fig. 2 Headwork Arrangement

Raw Water Pumping Machinery: Raw water will be pumped from the existing jack well to the existing WTP and the proposed WTP. Two separate pumping machinery is proposed, one for the existing WTP and one for the proposed WTP.

Table-3 Raw water Pumping machinery details

Sr. No	Type of Pump	Location	Head	H. P	Discharge
1	Vertical Pump.	From existing JW to existing WTP	89 m	150 HP (1W+1S)	3,16,800 lph
2	Vertical Pump.	From existing JW to proposed WTP	88 m	120 HP (1W+1S)	2,59,200 lph

Raw Water Rising Main: Existing Raw Water Rising Main is in good condition but for fulfilment of additional demand required addition rising main of diameter 350 mm.

Table-4 Raw water rising main details

Sr. No.	Location	Material	Length	Diameter
1	From Existing Jack well to Existing Water Treatment Plant	DI-K9	16,600 m	350 mm

2	From Existing Jack well to Proposed Water Treatment Plant	DI-K9	12,500 m	350 mm

Water Treatment Plant: As per proposed water demand we required Water treatment plant of capacity 12MLD. But Existing Water Treatment plant is 7.2 MLD Conventional type which is in very good condition. Thus, we propose additional 6 MLD Conventional water treatment plants.
The conventional Type Water Treatment Plant will have following units.

1. Aeration fountain
2. Flash mixer
3. Flocculator
4. Clarifier
5. Rapid Sand Filter House
6. Filter Snad, Wash Water Tank
7. Wash Water Pump
8. Air Blower
9. Chemical House in two Story's
10. Ground Floor to Accommodate 7 days alum Requirement
11. Solution Tank
12. Pure water Sump and Pump House

Pure Water Pumping Machinery: To meet the projected demand, the proposed pumping machinery in the pumphouse at the WTP sump is as follows:
Table-5: - Pure Water Pumping Machinery Details

Sr. No	Type of Pump	Location	Head	HP	Discharge
1	Vertical Submersible Pump.	From Proposed WTP Sump to U/C ESR at Madha Colony	33 m	15 HP (1W+1S)	17.97 LPS
2	Vertical Submersible Pump.	From Proposed WTP Sump to Existing GSR at WTP Campus	14 m	12.5 HP (1W+1S)	35.82 LPS
3	Vertical Submersible Pump.	From Proposed WTP Sump to under construction MBR at WTP Campus	28 m	60 HP (1W+1S)	95.33 LPS

Pure Water Rising Main:
Table-6: - Pure Water Rising Main Pipelines Details

Sr. No.	Location	Material	Length	Diameter
1	From Proposed WTP Sump to under construction Madha Colony ESR	DI-K9	1270 m	200 mm
2	From Proposed WTP Sump to Existing GSR at WTP Campus	DI-K9	50 m	250 mm
3	From Proposed WTP Sump to under construction MBR At WTP Campus	DI-K9	100 m	350 mm

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Pure Water Gravity Main: The Existing Gravity main from WTP Campus MBR to 7 numbers of Existing ESRs of 1) WTP under construction ESR, 2) Bhimnagar Existing ESR 3) Vetal Chowk Existing ESR, 4) Janta Chal Existing ESR, 5) Kalika Nagar under construction ESR, 6) Kamalaraje Chowk under construction ESR, 7) Dalit Wasti Existing ESR. And Swami Samarth Bhakt Niwas & Swami Samarth Annachatra.
The Total Ex. Length of Gravity main Network is 3370 M of Varying Diameters of (250,350& 400) of material DI -K7 remaining Gravity main Network is proposed of 2860 M.

Elevated Service Reservoir/Ground Storage Reservoir Details: Zone wise ESR / GSR Details is as below
Table-7: - Pure Water Gravity Main Pipeline Details

Sr. No.	ESR	Zone	Capacity In Lit	Staging in m
1	Under Construction ESR at Madha Colony	Zone-1	5.00 Lakh	12
2	Under Construction ESR at Kalika Nagar	Zone-2	3.00 Lakh	12
3	Existing ESR at Vetal Chowk	Zone-3	2.00 Lakh	12
4	Existing ESR at Janta Chal	Zone-4	2.10 Lakh	12
5	Existing ESR at Dalit Wasti	Zone-5	2.00 Lakh	12
6	Under Construction ESR at Bhim Nagar	Zone-6	2.00 Lakh	12
7	Under Construction ESR at Kamalaraje Chowk	Zone-7	5.00 Lakh	12
8	Under Construction MBR at WTP Campus	Zone-8	14.00Lakh	16
9	Under Construction GSR at WTP Campus	Zone-9	10.00Lakh	-

Distribution Network: The distribution network will cover 78,007 meters using HDPE and DI pipes of varying diameters (110 mm to 350 mm). Proper zoning has been designed for the distribution network so that proper water distribution can be done throughout the city of Akkalkot.
Household Connection: The Total Proposed Household Connection in Akkalkot city is 11,557 No's with AMR (Automatic Meter Reading).

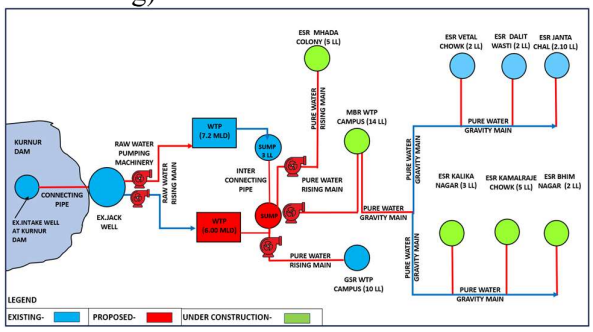

Fig. 3 Proposed Scheme Flow Diagram

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SMART WATER MANAGEMENT:

The project integrates modern technology solutions such as Automated Meter Reading (AMR) meters and Supervisory Control and Data Acquisition (SCADA) systems. These advancements will enable real-time monitoring, automated control, and efficient management of water consumption, ensuring transparency and resource optimization.

SCADA is vital as it is made available to enhance operational efficiency and monitoring along the water supply network. SCADA system's objective and features comprise:

- Centralized Control: SCADA system is to be central at WTP, which shall control remote stations like ESRs and pumps through a credible communication network.
- Real-Time Monitoring: The system will capture real-time information from a range of locations, such as water treatment facilities, intake structures, and ESRs, enabling operators to see how well they are performing and quickly spot problems as they occur.
- Failure Event Logging: SCADA will record every failure event, such as the failure of pumps or voltage conditions, so immediate corrective measures can be implemented.
- Data Acquisition & Reporting: The system will monitor the most important parameters like voltage, current, power factor, and water flow and generate customizable reports for future use.
- Alarm and Fault Alarming: SCADA will offer alarms for power supply faults, pump malfunctioning, and voltage deviation to ensure continuous operations.
- Water Quality Monitoring: Equipment like pH and turbidity meters will be linked to SCADA to make sure that the quality of the water complies with regulations.
- AMR meters and bulk flow meters will be used to monitor water consumption more efficiently.

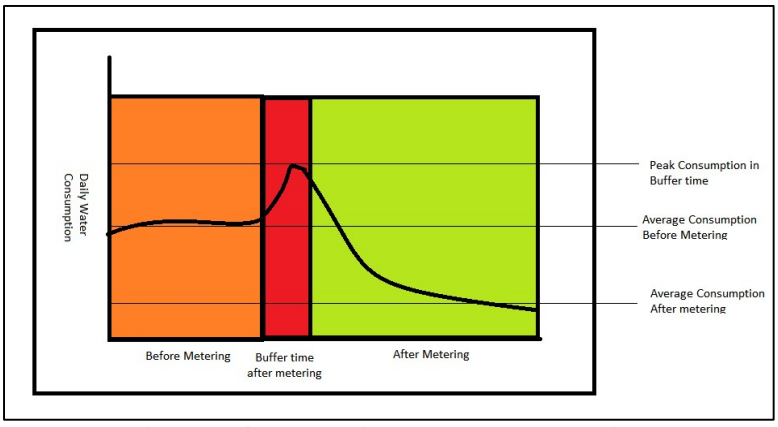

Fig. 4 After Metering Water Consumption

LITERATURE REVIEW:

The provision of 24x7 water supply in urban areas is a critical goal for improving public health, ensuring equitable distribution, and enhancing the efficiency of water resource management. Several case studies and reference documents have been reviewed to understand best practices, challenges, and key components of continuous water supply projects. The following literature has been examined for insights into planning, implementation, and sustainability of 24x7 water supply schemes:

1. Drink from Tap Mission – A Case Study of 24x7 Water Supply in Puri City (CPHEEO, MoHUA, Government of India, November 2021) [7]

Puri, Odisha, was the first city in India to introduce a city-wide 24x7 water supply network under the 'Drink from Tap Mission'. It was a part of AMRUT 2.0 and had the vision of eradicating the end consumer's need for water purification.

2. Success Story of Malkapur 24x7 Water Supply System (Maharashtra Jeevan Pradhikaran, Government of Maharashtra) [10]
   Malkapur, Maharashtra, is among the path-breaking towns in India where the intermittent water supply system was shifted to a continuous one.
3. Latest CPHEEO Manual on Water Supply and Treatment System (Ministry of Housing and Urban Affairs, Government of India) [1]
   The new CPHEEO handbook offers detailed directions for the enforcement of 24 x 7 schemes of water supply, highlighting: Service Level Benchmarks: Minimization of NRW to less than 20%, 100% metering, and residual pressure maintenance.
   Infrastructure Planning: Significance of zoning, hydraulic modeling, and ongoing monitoring. Technology Integration: SCADA, IoT-enabled smart meters, and GIS-based asset management recommendations.
4. Technical Data Book, Indian Water Works Association (IWWA) [3]
   Network Design: Hydraulic considerations for continuous water supply. Water Demand Estimation: Guidelines for per capita demand assessment. Leakage Management: Methods for NRW reduction through proactive monitoring and repairs.

DISCUSSION:

The plan for the development addresses the existing gaps and the future needs at the same time. The objective of the project is to incorporate smart technologies with the aim of reducing inefficiency in operations and improving service delivery. With the addition of real time monitoring, maintenance can be performed proactively which greatly reduces losses while ensuring proper distribution.

CONCLUSION:

Augmenting and Smart Drinking Water Management at Akkalkot Municipal Council is a landmark achievement in making sure the population of Akkalkot has safe and reliable drinking water. The project has resulted from planning, strategic implementation, and advanced technology to achieve certain objectives that significantly transformed the water supply infrastructure and management in the region. Above all, with the completion of this effort, Akkalkot Municipal Council can provide around-the-clock access for residents. The transition to 24x7 service will ensure that all households in the municipality have enough drinking water access with the adequate volume of 135 Liters per capita per day, which represents a major improvement in accessibility of water supply services and development in quality of life, public health hygiene. In addition, the expansion of pipeline networks to provide access to all households in the municipality will ensure equitable distribution and availability of water resources. This project finally solves the longstanding problem of unequal access to water resources and contributes to social equity and inclusion.

Along with improving water access, the project also deals with improving quality. The water supplied to the residents is treated using modern methods and meets quality assurance standards to ensure that safe, potable water that minimizes health risks is supplied to the public while keeping contaminants out of the water. Additionally, the project incorporates Supervisory Control and Data Acquisition (SCADA) systems into the water supply and distribution network, which brings a new perspective and form of management and operations. This ability for real-time monitoring and control makes operations more efficient, enables maintenance to be proactive rather than reactive, provides less down time, and utilizes resources more efficiently to improve cost efficiencies. The incorporation of smart metering technology will also significantly reduce Non-Revenue Water (NRW) improving both water

conservation and financial sustainability. Smart metering can also measure water usage accurately and identify leaks or illegal use, reducing losses, improving revenue collection, and increasing the financial sustainability of the water supply system.

In summary, the Augmentation and Management of Drinking Water Supply Scheme for Akkalkot Municipal Council is an example of a holistic approach to the management and service delivery of water resources. By providing reliable and sufficient access to safe drinking water along with improved operational efficiency and sustainability, the project is a model for better urban water management for present and future generations.

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