ANALYSIS OF WATER SUPPLY DISTRIBUTION NETWORK FOR NEW EMERGING SMART CITY OF GUJARAT – A CASE STUDY OF DAHOD

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ABSTRACT

Water Supply has remained most critical issue for all Urban Local Authorities because of improper operation and management of the system. In order to fulfill the water demand of the continuously growing population, it is essential to provide the sufficient and uniform quantity of water through the designed network of pipes.

The specific objective of this study is to analyse the existing water supply distribution system of ward number 4 in Dahod city as well as analysis of Pressure, Velocity, Head loss, and Efficiency at each node using Water gems software & to check feasibility of current water distribution system. The main aim is to Analysis of Water supply distribution network and identifies various problems for modification of current water supply distribution system. For this analysis the present data of water distribution system was collected from Dahod Nagar Palika. Water demand for next three decades for ultimate year 2041 will also compute & Nodal demand will also calculate for ultimate year by collecting the data of population at each node. Hydraulic analysis is done for pipes & nodes for both existing population & forecasted population.

This paper present analysis of hydraulic parameters of water supply distribution system for existing population as well as forecasted population of ward no.4 in Dahod City.

Keywords: *Water supply distribution system, Hydraulic parameters, Population forecast, Water demand, Water gems.*

INTRODUCTION

Water is the most precious gift and important Infrastructure. Providing efficient Water supply system which includes collection, transmission, treatment, storage and distribution of water for homes, commercial establishments, industry, and irrigation, as well as for public needs as firefighting and street flushing is first essential thing for any governing body (Nagarpalika). If it is not provided sufficient indirectly the local people will directly affect the growth of the society. So this study is for making existing water supply network effective by eliminating water losses & other problems.

According to Gujarat Infrastructure Development Board, Gujarat is characterized by variations in the topography and wide variations in annual rainfall. 3/4 area of the State is unsuitable for ground water withdrawal due to rocky terrain and coastal region. Further, the supply of surface water is limited and thus, the State has a long recorded history of droughts. The total water availability in the Gujarat state is 50 BCM of which surface water accounts for 38 BCM and ground water accounts for the balance 12 BCM. Of the 38 BCM of surface water, more than 80% is being used for irrigation purposes, leaving limited supply for drinking and industrial uses, which are therefore, largely dependent on ground water. With increasing population and economic growth, water demand is likely to pick up considerably in the future.

NEED OF STUDY

There is a boom increment in Population in Urbanization as well in Rural and because of that a Water demand wills also being increased for all the purposes such as Residential & Industrial areas. In spite of Generating new Water sources so there are no possibilities of generating water sources instead of that efficiency of the existing Water supply network can be improved.

The maximum issues are related to the improper operations of the system and if the system can be redesigned so that the Problem can be solved for the feasibility or the continuous water supply to the existing networks.

OBJECTIVES

To Analyze the Existing Water supply distribution system for checking Hydraulic Parameters such as Pressure, Velocity, Head loss and Efficiency at each Junction (Node). & To suggest some measure if Present network does not fulfill the Present & Future demand.

STUDY AREA PROFILE

The details of Dahod city is mentioned in Table 1.The Dahod Nagarpalika area has been divided into 9 wards. Ward no.4 is selected for the analysis purpose because the maximum residential area covers under this ward as in figure 1.

Figure 1 Study area which includes ward no. 4 in Dahod city.

Table 1 Fact file of Dahod city

1	AVERAGE RAINFALL	750mm
2	RIVERS	4
3	AREA	3733 sq.km.
4	POPULATION OF WORD NO. 4 IN DAHOD CITY	10,998
5	STRENGTH	At present Dahod city is getting water from kadana dam which has gross capacity are 44118.61 MCFt. (1249.30 MCM.) & annual requirement of Dahod city is 0.89 % of gross capacity of kadana dam.
6	WEAKNESS	The water supply distribution of Dahod city is limited to 2-3 days in a week {hourly base}.

DESIGNING OF EXISTING WATER SUPPLY DISTRIBUTION NETWORK IN WATERGEMS

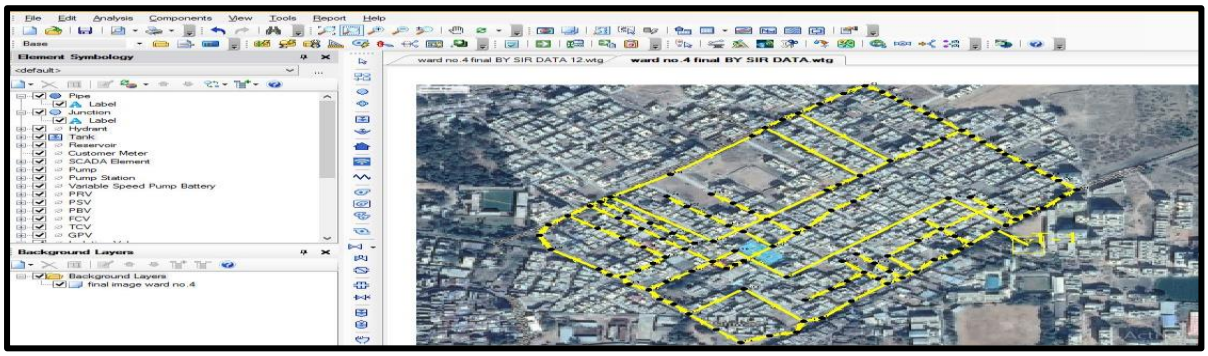


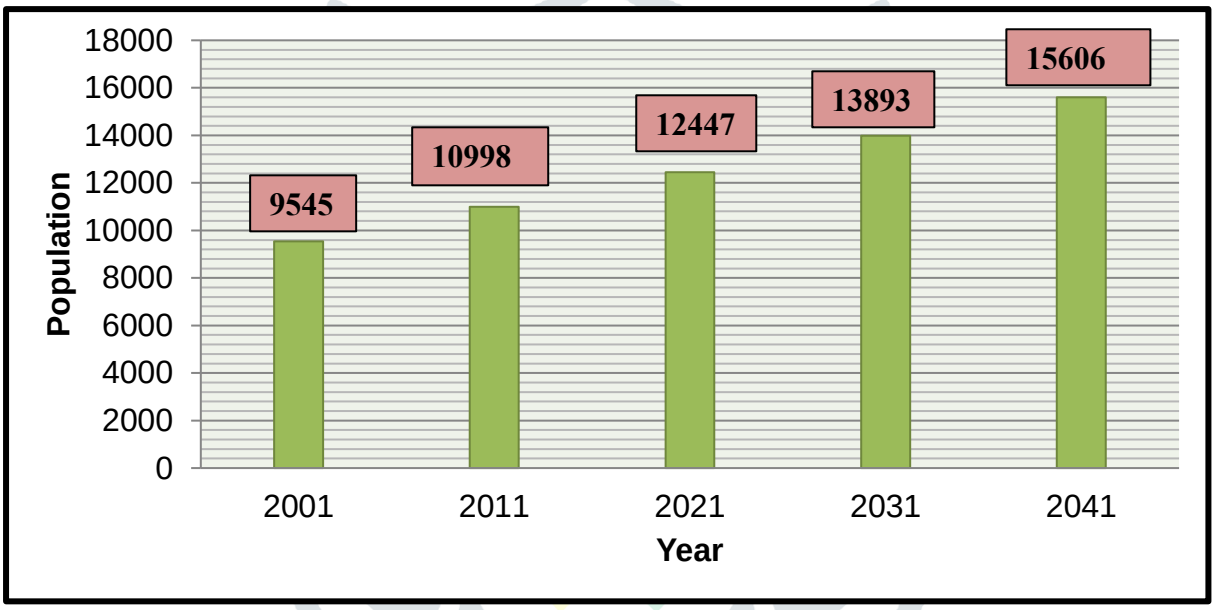
Figure 2 EXISTING WATER SUPPLY DISTRIBUTION NETWORK

Figure 2 shows study area which is designed by using Water gems software incorporating with Google Earth. Scaling of images has been done accurately through Google earth.

- **Why WaterGEMS software are more benefited than other software's:**
  - Because it has capabilities like,
  - Analyse pipe and valve criticality
  - Assess fire flow capacity
  - Build and manage hydraulic models
  - Design water distribution systems
  - Develop flushing plans
  - Identify water loss
  - Manage energy use
  - Prioritize pipe renewal
  - Simulate networks in real time.

DATA COLLECTION & ANALYSIS (WARDNO.4)

POPULATION FORECAST



Graph 1 Population Forecast

Graph 1 indicates that population forecast of ward no.4 which is calculated by incremental increase method.

PIPE PARAMETERS

Table 2 Pipe Parameters

NODE	123 (JUNCTIONS)
TYPES OF PIPES	1) HIGH-DENSITY POLYETHYLENE PIPE (H.D.P.E. PIPE) 2) DUCTILE IRON PIPE (D.I. PIPE) 3) MILD STEEL PIPE (M.S. PIPE)
DIAMETERS	1) H.D.P.E. PIPE – 80mm Ø – 200mm Ø 2) D.I PIPE – 250mm Ø – 400mm Ø 3) M.S. PIPE – ABOVE 400mm Ø

Table 2 indicates that various pipe parameters of existing water supply network

WATER DEMAND CALCULATION

Table 3 Water Demand Calculation

YEAR	POPULATION	WATER DEMAND IN MLD	15% UNACCOUNTED FLOW OF WATER	FIRE FLOW	TOTAL DEMAND(MLD)
2001	9545	1.33	0.19	0.308	1.82
2011	**10998**	**1.53**	**0.22**	**0.330**	**2.08**
2021	12447	1.74	0.26	0.352	2.35
2031	13983	1.95	0.29	0.372	2.61
2041	**15606**	**2.18**	**0.32**	**0.394**	**2.89**

Table 3 indicates that analysis of water demand calculations such as water demand in MLD, 15% unaccounted flow of water, fire flow & additions of all demands.

NODAL DEMAND CALCULATION

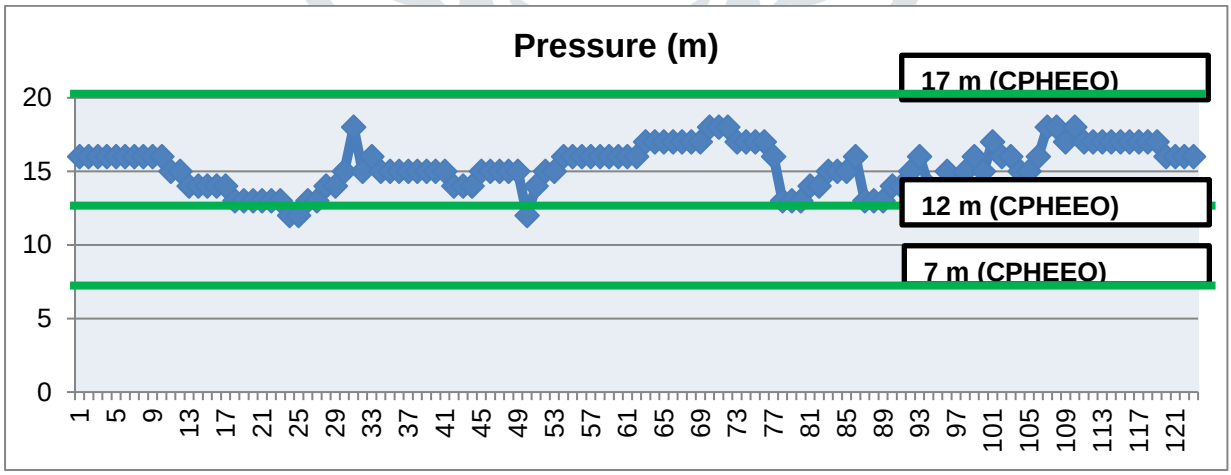
FOR PRESENT POPULATION = PRESENT TOTAL DEMAND IN MLD/TOTAL JUNCTIONS
= 2.08/123
= **0.016**
FOR FUTURE POPULATION = FUTURE TOTAL DEMAND IN MLD/TOTAL JUNCTIONS
= 2.89/123
= **0.023**

HYDRAULIC PARAMETERS

CRITERIA FOR PRESSURE:
As per *Central Public Health & Environmental Engineering Organization* a Distribution system should be designed for the:-

- Single storey building = 7 m
- Two storey building = 12 m
- Three storey building = 17m

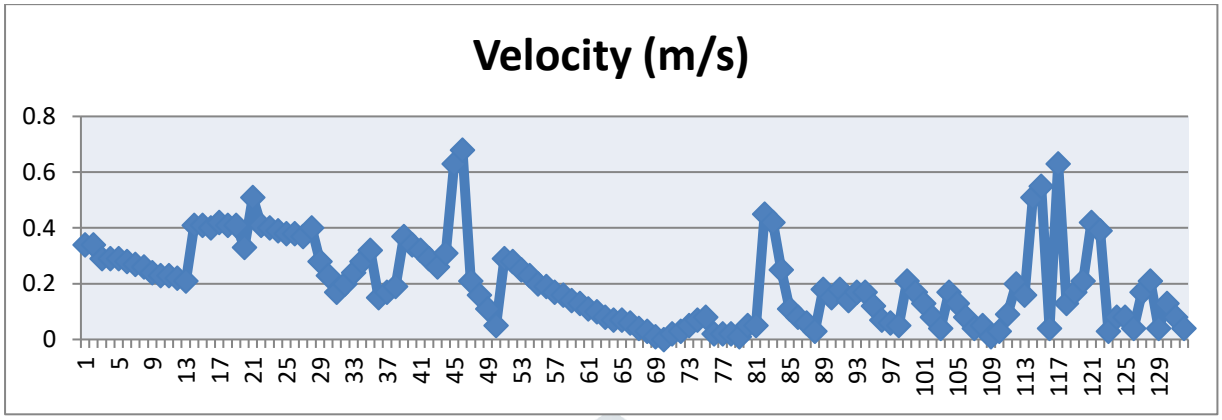
PRESSURE ANALYSIS



Graph 2 Details of Pressure at all Nodes.

Analysis of Pressure at each Junction by adding some existing hydraulic parameters such as Pipe Diameter, Elevation of Nodes, Water tank and Water Demand of study area has been performed as in Graph 2. & as the results are falling under CPHEEO guidelines.

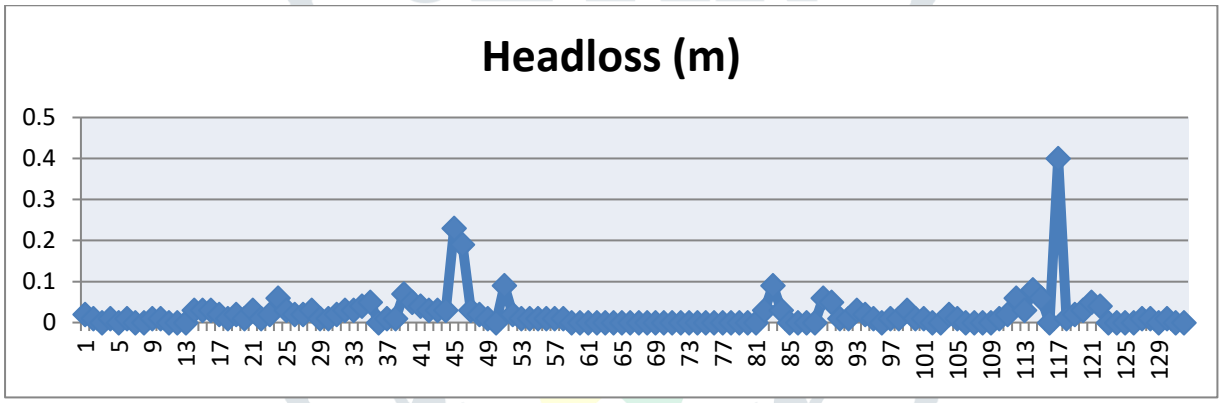
VELOCITY ANALYSIS



Graph 3 Details of Velocity at all Pipes.

Velocities of water flow in pipes are varying because of change in diameters of the pipe as in graph 3. Use of same diameter pipes at each junction will make the existing system more workable & efficient.

HEADLOSS ANALYSIS



Graph 4 Details of Head loss at all Pipes.

At few junction head loss is very high due to sudden change in pipe diameter as in Graph 4 & This problem can be solved by using same diameter of pipes or changing existing diameter of pipes for effective water distribution network

FINDINGS

- Optimization of Pressure, Velocity & Head loss through changing diameter of Pipelines specifically between 43 no. to 55 no. & 115 no. to 120 no. Junctions.
- For Present & future population a Water demand difference of this study area is not much more & for some Pipelines Hydraulic parameters did not full fills its requirement so there is requirement of simulate existing Water supply distribution systems.
- Cost can be reduced by changing diameter of pipes at several junctions for 24×7 water supply.
- A water metering should be compulsory at every household so automatically people can use water only which is required & no other wastage of water is done.

CONCLUSION

At the end of the analysis it was found that the resulting pressure at all nodes and the flows with their velocities are sufficient but in some Pipes, Pressure difference are more and velocity is less & Head loss are more so we can improve this by Optimizing diameter of Pipelines to the study area which also helps in reducing the cost.

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