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Assessment of Water Distribution WEST Zone of Surat City, Gujarat

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Abstract: ***This project explores the use of assessment to assess the operational performance of Water Distribution Networks (WDNs) and exemplifies its suitability to easily identify problematic zones. The project also points out some problems associated with the existent distribution system and proposes new analysis to avoid these difficulties. These analysis are conjugated for illustration purposes, including environmental, physical and operational performance assessment of water distribution system.***
Keywords: Urban water supply and distribution system, Evaluate Parameters, Physical parameters, Operational parameters, Environmental parameters.

I. INTRODUCTION

Human life, as with all animal and plant life on the planet, is dependent upon water. Not only do we need water to grow our food, generate our power and run our industries, but we need it as a basic part of our daily lives - our bodies need to ingest water every day to continue functioning. "Basic needs of about 70litres per person per day". It includes the need for water to maintain a basic standard of personal and domestic hygiene sufficient to maintain health. The effects of inadequate water supply causes disease, time and energy expended in 3daily collection, high unit costs, etc. provision of basic daily water needs is yet to be regarded by many countries as a human right. Despite some shortcomings in their performance, urban water supply and distribution system have provided urban dwellers with water for years; There have been widespread criticisms of these system functionality since the introduction of sustainable development concept in the late 1980`s. Therefore, environmental, physical and operational criteria don`t have significant roles in decision making. There is a need to apply method such as sustainability assessment method which can assess the urban water development projects in Surat with regard to the main objectives of sustainable development.

II. NEED OF STUDY

Water is the basic necessity of mankind though it is not sufficiently provided to each urban dwellers. In some area there is large quantity is available ; whereas in some area there is hardly sufficient water is there. This project intended to explore current water distribution system and suggest some measures to improve these phenomena so that water can reach to everyone.

III. SCOPE OF STUDY

Study is limited up to the increase the accessibility of water supply in pal area . Water is supplied to the urban dwellers though existing water distribution system though some problems are there. This project explores the improvement in the existing water supply system, studying different parameters of system closely and give some suggestions for improvement in that time parameters.

IV. STUDY AREA PROFILE

Surat is the 4th fastest developing City. It is 34th largest City by area in India. According to census 2011, Surat has 4.78 million populations and area of 326.515 square km. Due to nearness of Arabian Sea, Climate of the City is humid and hot. In the summer, temperature ranges from 37° C to 44°C. The maximum humidity in the City is 80%. In the winter temperature ranges between 10°C to 15.50°C. .The Arabian Sea is to its west at a distance of about 22 kilometres along the Tapi and about 16 kilometres by road. The location of Surat is 21^{o}15'N Latitude and 72^{o}52'E Longitude.

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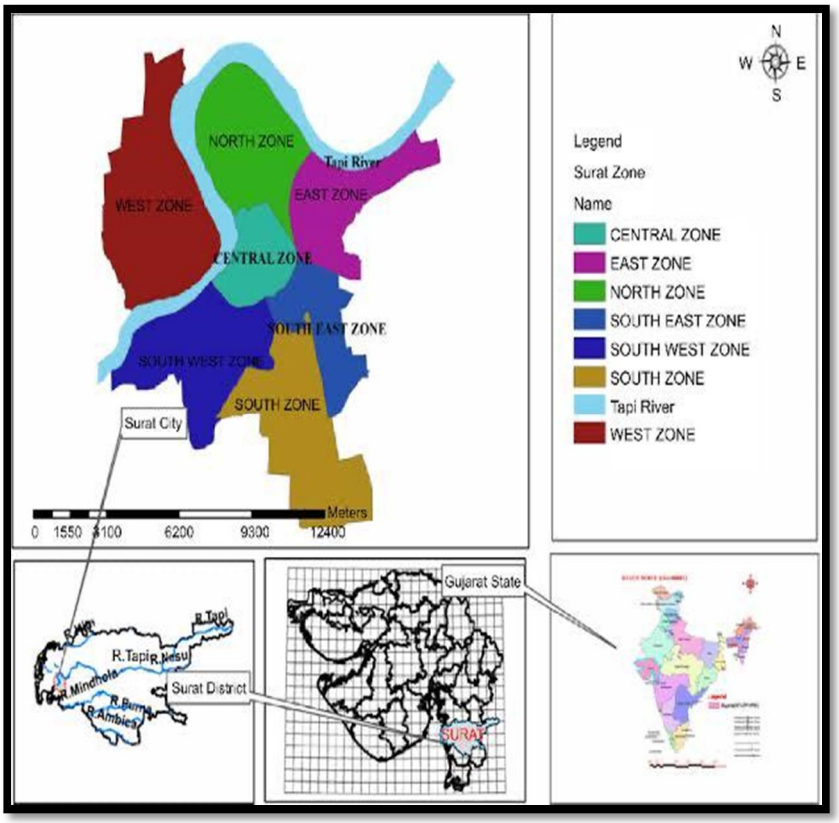

Fig. 1 Study area Surat city

TABLE I
Zone, area, population, density and population of house hold of Surat City

Sr No	Zone	Area (sq.km)	Population		Density (sq.km)	Details of household and population		Total no of Census Houses	Total no of household
			2001 census	2011 census		Household	Population		
1	Central	8.018	413641	408760	49971	9889	49323	153638	80939
2	South west	111.912	242466	347447	3105	7502	33982	114734	72437
3	South	61.764	407980	695028	11253	17887	76025	251079	167629
4	South East	19.492	397257	748304	38390	30051	147050	221643	155732
5	East	37.525	711516	113713	30303	21334	90992	313105	234327
6	North	36.363	416370	705163	19392	13541	58293	201978	141898
7	West	51.279	287144	424986	8288	5665	25993	130068	93344
Total		326.515	287637	446682	13680	105869	481658	1386245	946306`

V. WEST ZONE

West Zone also known as Rander Zone of the Surat city is enclosed by the River Tapti as shown in West Zone of the city is one of the oldest and adjoin to the walled city area. Out of total seven zones of the city West zone have a total five wards uptil the year 2006 which includes Rander(14-26), Adajan(27) ,Jahangirabad (63), Jahangirpura (64), Pisad (65), Pal (67), Palanpor (68) Vaiyav(69). Out of these wards the Rander zone area is successfully implemented by many Town Planning Schemes.

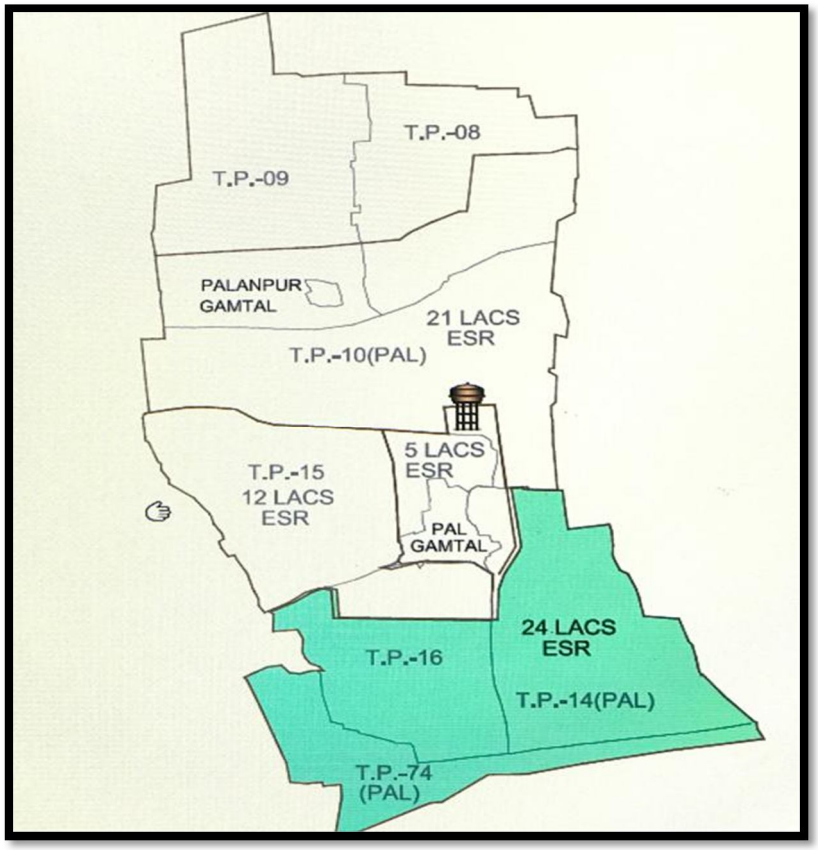

Fig. 2 Key Plan of TP

Total area of west zone is 51.279 km^2 . From toatal area of west zone of surat city ESR 3 is selected, which is situated in pal area and contain 3 town planning schemes; TP 14, TP 16 , TP 74 respectivaly. Capacity of ESR is of 24 lacs. The house hold survey is conducted in these 3 TP schemes. Timing of water supply in this ESR is 2 hours. From the analysis of household survey we are able to identify actual problems faced by unban dwellers.

યોજનાનું ટુંક વિવરણ				આ પ્રોજેકટ હેઠળ આવરી લીધેલ	
				વિસ્તાર (હેકટરમાં)	અંદાજીત વસ્તી (૨૦૧૪)
ન્યુ વેસ્ટ ઝોન (પાલ-પાલનપુર) ઓવરહેડ ટાંકી	(૧)	ESR-4 (૨૧ લાખ લીટર)	ટી.પી.સ્કીમ નં.૧૦ (પાલ) પાલનપુર ગામ પૈકી	૭૩૭.૮૬	૭૩૭૮૬
	(૨)	ESR-2 (૧૮ લાખ લીટર)	ટી.પી.સ્કીમ નં.૮,૯ પાલનપુર ગામ પૈકી		
	(૩)	ESR-1 (૧૨ લાખ લીટર)	ટી.પી.સ્કીમ નં.૧૦ (પાલ) પાલનપુર ગામ પૈકી		
	(૪)	હયાત ૫ લાખ લીટરની ટાંકી	પાલ ગામતળ		
	(૫)	ESR-3 (૨૪ લાખ લીટર)	ટી.પી.સ્કીમ નં.૧૬,૧૪ (પાલ), ૭૪ (પાલ)		

Source: Surat municipal corporation

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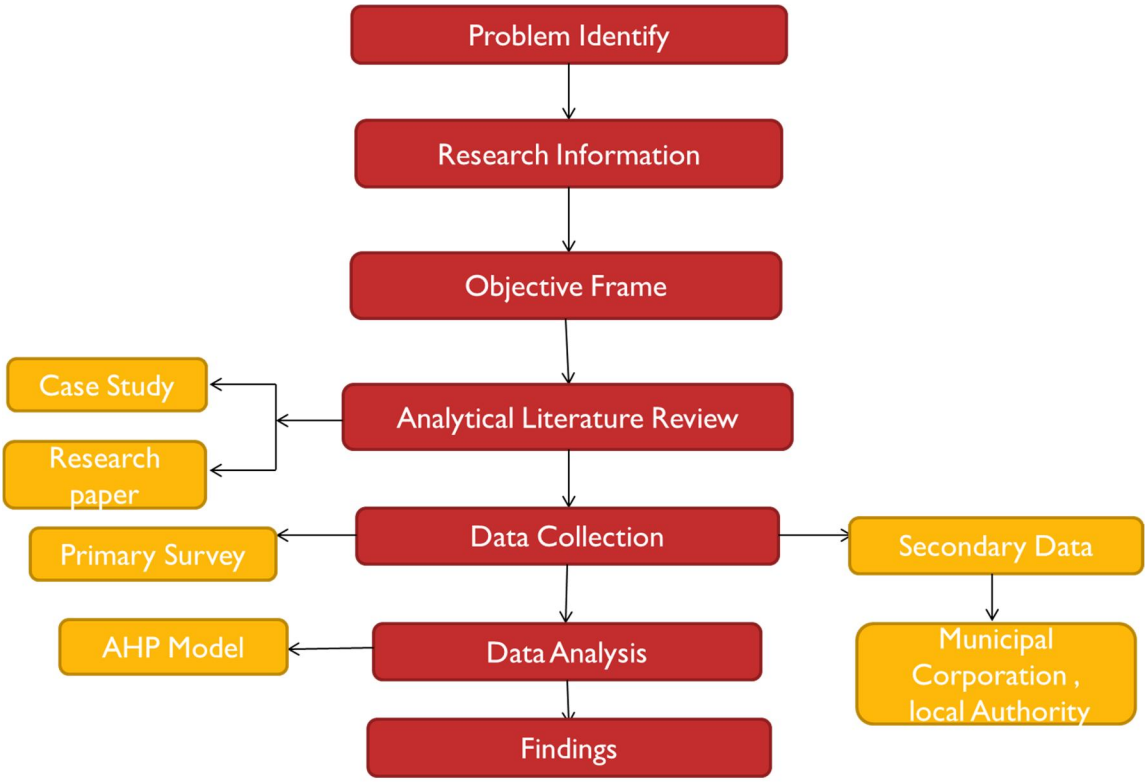
VI. METHODOLOGY:



First step in methodology is to identify various of problem occurring in existing water distribution system. Next stage is research regarding information which is carried out in initial stage. After then main important part of project is for which purpose it is carried out its objective and future scope plays a key role. In literature part mainly take case study of assessment of existing distribution system and AHP model is studied

Data collected in various stages like in terms of primary and secondary. In primary data collection, house hold survey is conducted to know various information regarding water distribution system. In secondary data collection, map collection of different distribution network and expert advice are included. Next step is to analyse collected data .It is divided into three parts. Map analyse, house hold survey and expert survey. Expert survey is further divided into three parameters.

These all data are analysing through ―Analytical hierarchy process‖. Each parameter is design different parameter.

VII. DATA COLLECTION

A. General

Data are collected from municipalities: The collected data include physical, environmental, and operational factors i.e., pipe material, age, diameter, and pipe age ; soil type, C factor, pipe depth, cathodic protection, etc.. The collected data are sufficient to verify and validate the developed model.

A questionnaire was also sent to municipal authority and experts. Data regarding the subjective assessment of main factors and their sub factors were collected from practitioners' municipal engineers, consultants. Their responses include pairwise comparison matrices among main factors and sub factors. Questionnaires were sent to different experts and consultants. Twelve responses 24% were received, which were incorporated to develop the weight and priority of the deliberated factors and their sub factors.

For any type of survey, sample size is very important and essential to get proper result. For deciding sample size taken following method. In this method confidence level is taken 95% and the margin of error taken 5%. Population of this selected study area is 2,95,881 that was taken for the calculation.

For deciding the sample size a formula used is of Hogg and Tannis, 2009

$$n = \frac{m}{1+\frac{m-1}{N}}$$

N = Available population m is denoted by,

$$m = \frac{z^2 * p * (1-p)}{\varepsilon^2}$$

p = The value of the population proportion that is be estimated = 0.5

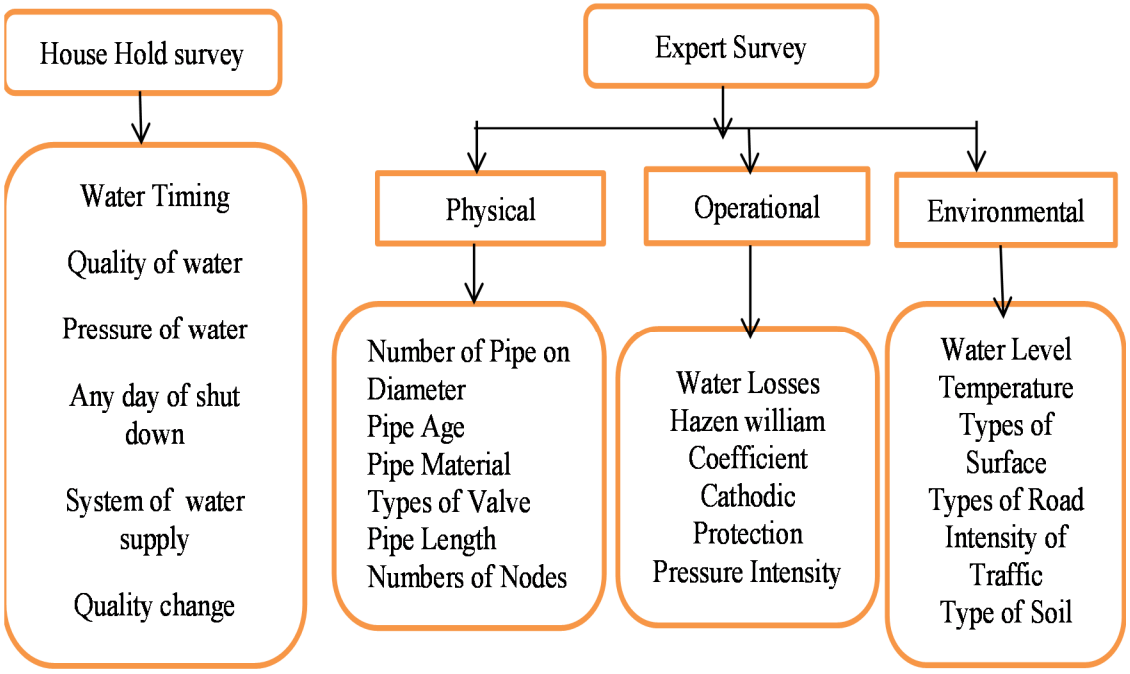
ε = The sampling error of the point estimate = 0.0

The type of the sampling which is taken by in this survey is mainly random sampling. The methodology of the survey is to randomly collect 383 samples per enumerator irrespective of the population of the zones. The net total samples in the zones are in variation as per the population of the zone. When we judge the survey by the city level scenario we get 78 samples. This report covers the zone level scenario of the west Zone of surat city.

Table II
Sample size Excel Sheet:

	Confidence level = 95%			Confidence level = 99%		
	Margin of error			Margin of error		
Population Size	5%	2.50%	1%	5%	2.50%	1%
100	80	94	99	87	96	99
500	217	377	475	285	421	485
1000	278	606	906	399	727	943
10000	370	1.332	4.899	622	2.098	6.239
100000	383	1.513	8.762	659	2.585	14.227
500000	384	1.532	9.423	663	2.64	16.055
1000000	384	1.534	9.512	663	2.647	16.317

B. Selection Of Various Parameters



After reading numerous research paper of different experts and understanding the key aspects of water distribution system aforementioned parameters are finalized

C. Information Of The House Hold Survey

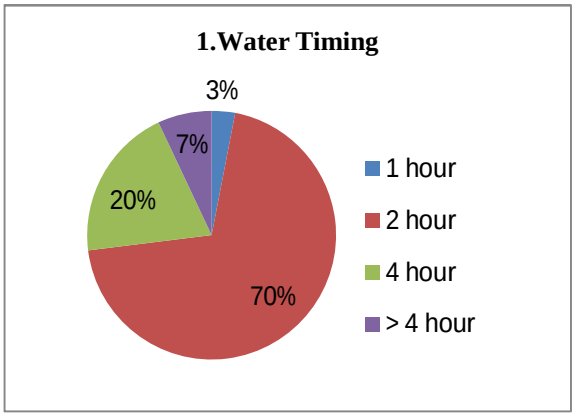


Fig. 3 Timing of Water supply

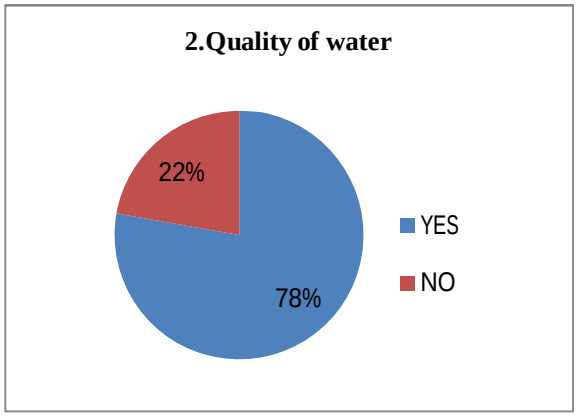


Fig. 4 Quality of Water

Figure1 inIdicates Water Timing 1 hour 3%, 2hour,70%, 4 hour 20%, and more than > 4 hour having a sample size 7%.
Figure 2 sample size 70 % people agree with Quality of water and rest of 30% is not agree.

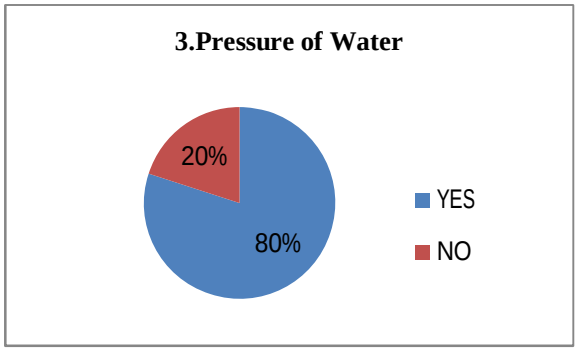


Fig. 5 Pressure of Water

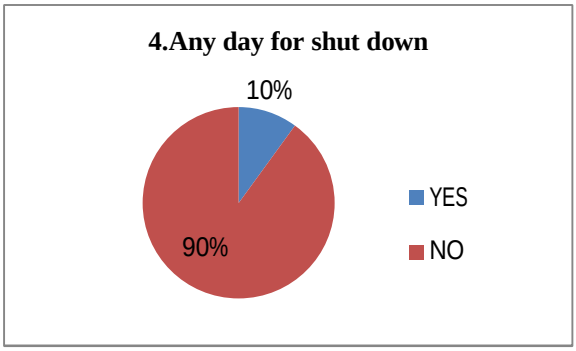


Fig. 6 Any day for shut down

Figure3. Indicate that sample size of 80% is satisfied with pressure of water and other than say 20%.
Figure4. indicate that 90% of people say there is NO day for shut down.

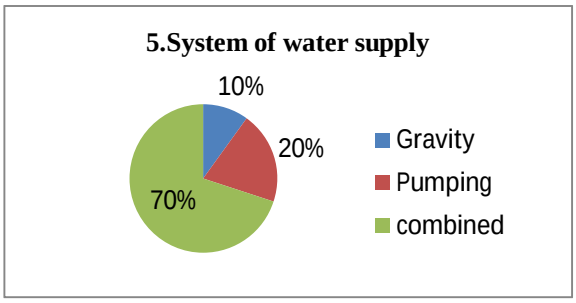


Fig. 7 System of water supply

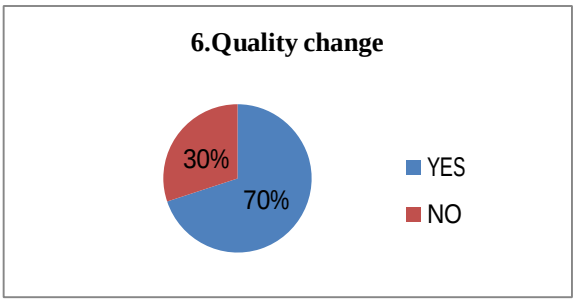


Fig. 8 Quality change

Figure 5. repPresent 70% of water is supply by combined system, 20% of water is supply by pumping system and 10% of water is supply by gravity system.
Figure 6. indicate 70% of sample size holds the view that water quality change according to season.

D. Expert Survey Analysis

1) Physical Parameter

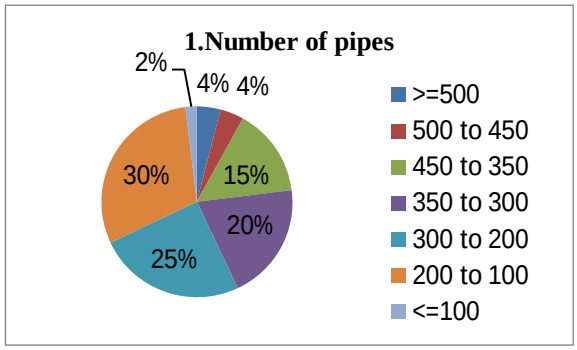


Fig. 9 Number of pipes

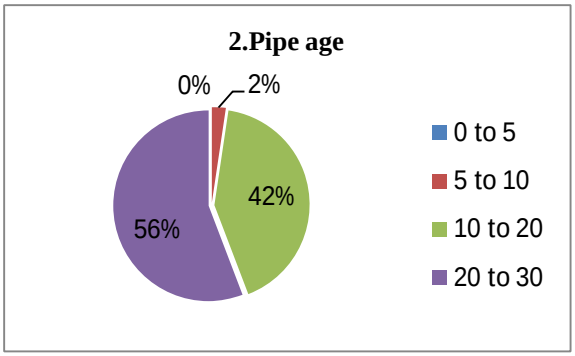


Fig. 10 Pipe age

Fig 7 indicates 30% of pipes are of 100 to 200 mm diameter,25% of pipes are of 300 to 200mm and 2% of pipes are of less than 100 mm diameter

Fig 8 represents 56% of pipes are of 20 to 30 years age while 42% are of 10 to 20 mm diameter

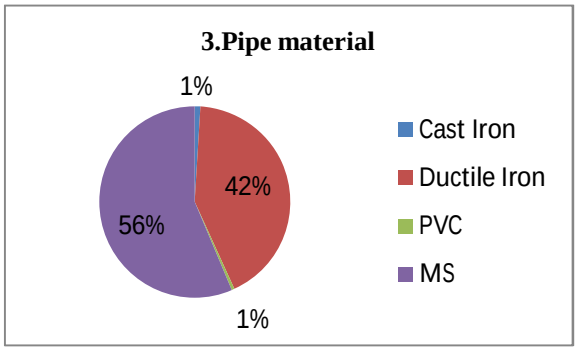


Fig. 11 pipe material

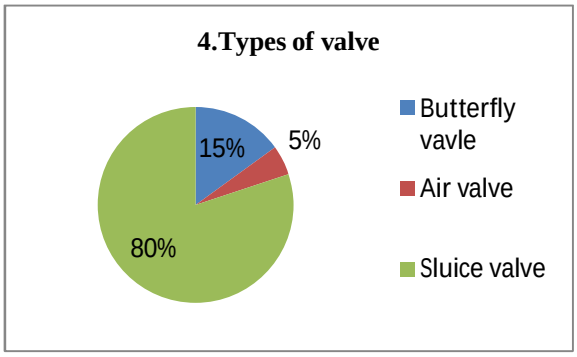


Fig. 12 Types of valve

Figure 9 depicts 56% pipe material is of MS and 42% are of ductile iron.

Figure 10 indicates 80% of water supply system contains sluice valve and 15% contains butterfly valve.

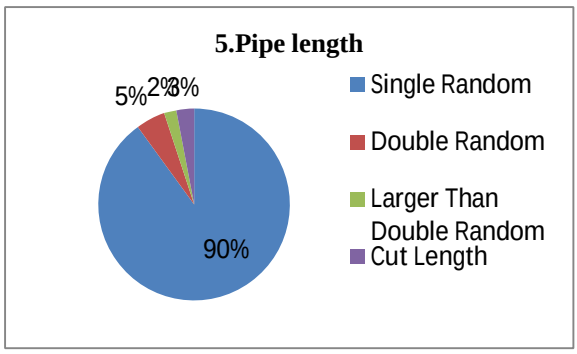


Fig. 13 Pipe length

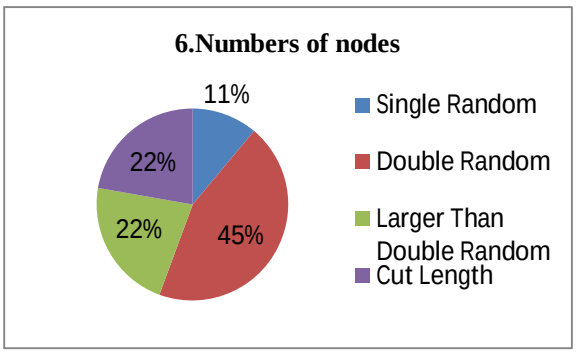
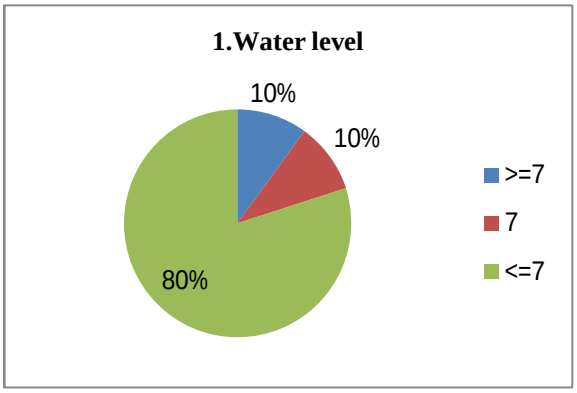


Fig.14 Number of nodes

Figure 11 indicates 90% of pipe length are of single random and 5% are of double random

Figure 12 indicates 45% of number of pipes are of double random, and 22% are of larger than double random and cut length.

2) Enviromental Parameters



Water level

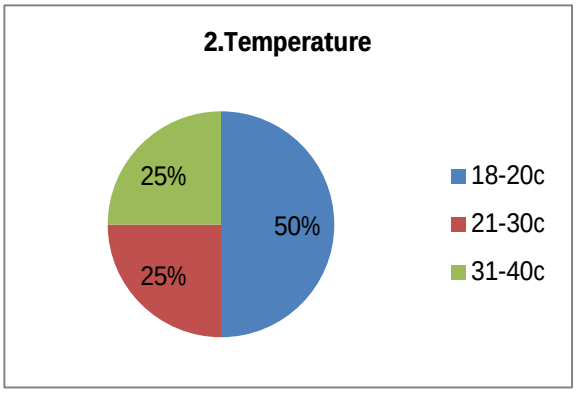


Fig. 16 Temperature

Fig. 15

Figure 13 indicates 80% of water level is less than 7m and 10% water level is 7m and gretar than 7m.
Figure 14 represents 50% temperature is of 18 to 20c and 25% is of 21c to 40c .

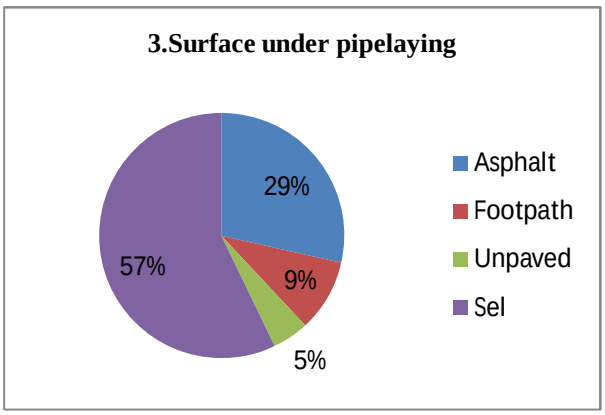


Fig. 17 surface under pipe laying

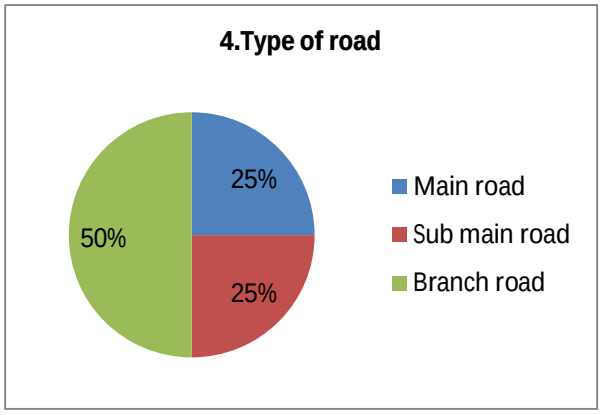


Fig. 18 type of road

Figure 15 indicates 57% of surface under pipe lying is sell: whereas 29% of surface is asphalt.
Figure 14 represents 50% of road is main road and 25% of road is sub main and branch road.

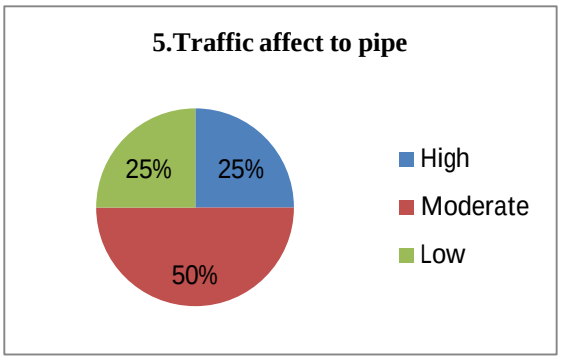


Fig. 19.Traffic affect to pipe

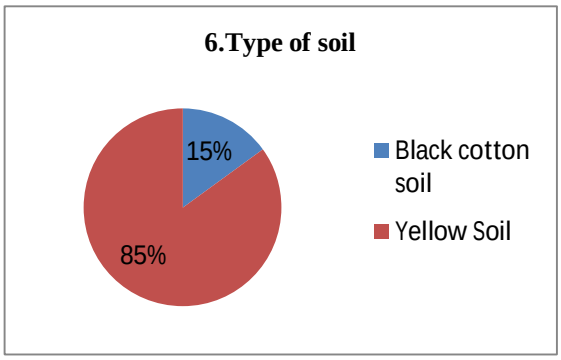


Fig. 20. Type of soil

Figure 13 indicates 80% of water level is less than 7m and 10% water level is 7m and gretar than 7m.
Figure 14 represents 50% temperature is of 18 to 20c and 25% is of 21c to 40c .

3) Operational Parameters

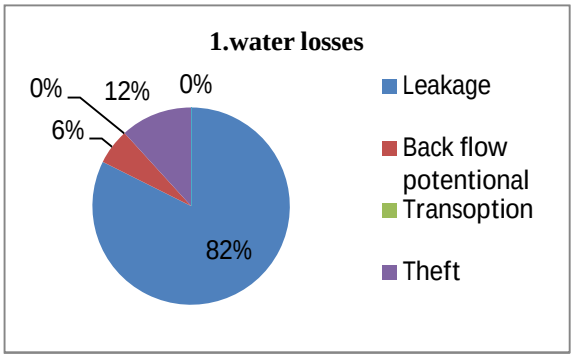


Fig. 21 water losses

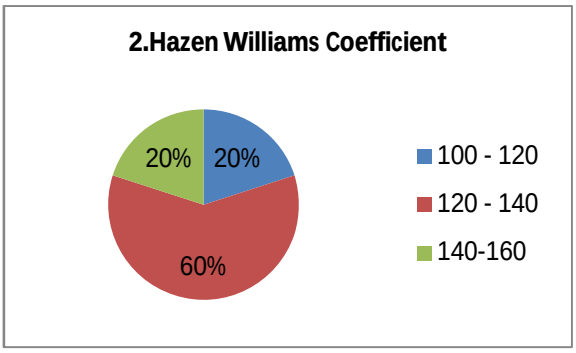


Fig. 22 Hazen William coefficient

Figure 19 indicates 82% water losses are from leakage and 12% are from theft.
Figure 20 indicates 60% of hazen William coefficient is 120-140 and 20% is of 100-120 and 140-160

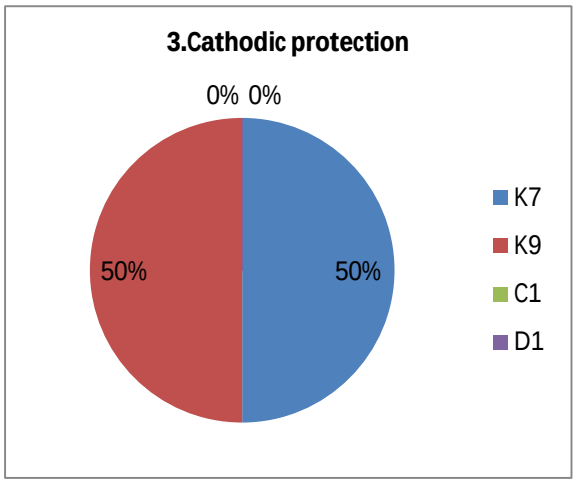


Fig. 23 Cathodic protection

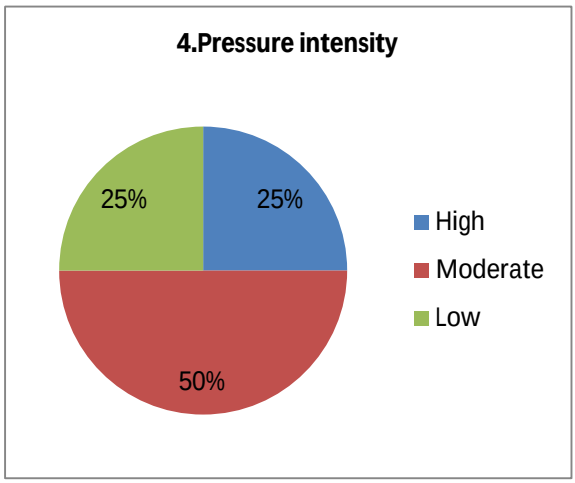


Fig. 24 Pressure intensity

Figure 21 depicts 50% of cathodic protection is of K7 and 50% is of K9
Figure 22 indicates 50% of pressure is moderate while 25% is high and low.

VIII. CONCLUSION

A. On the basis of the survey conducted for the west zone of surat city, we can consist of major proposition of population of timing of water supply (2hour). It is observed that maximum section of people quality of water and pressure of water supply is satisfied are there in this zone.

B. Though the water supply facilities are good in this zone but many factors affecting the water supply.

C. Now, if we talk about parameters like physical parameters in this zone maximum diameter of pipe for water supply is 200 to 300 (30%).pipe age is maximum 5 to 10 years ,pipe material is use maximum ductile iron(42%), valve is use sluice valve (80%)and number of nodes is according to length is larger than double random (45%) in this zone.

D. This zone consists of many environmental parameters affecting like water level maximum is less than equal to seven (80%),temperature in different season is maximum 18 to 20(50%),surface under pipe laying is there maximum sell (57%),traffic affecting to pipe is moderate (50%).

E. Operational parameters affecting in this zone for water supply are water loss is maximum for leakage(82%),hazen Williams coefficient is affect 120-140(60%), cathodic protection for pipe is maximum k7 and k9(50%), pressure intensity for water supply in this zone is moderate (50%).

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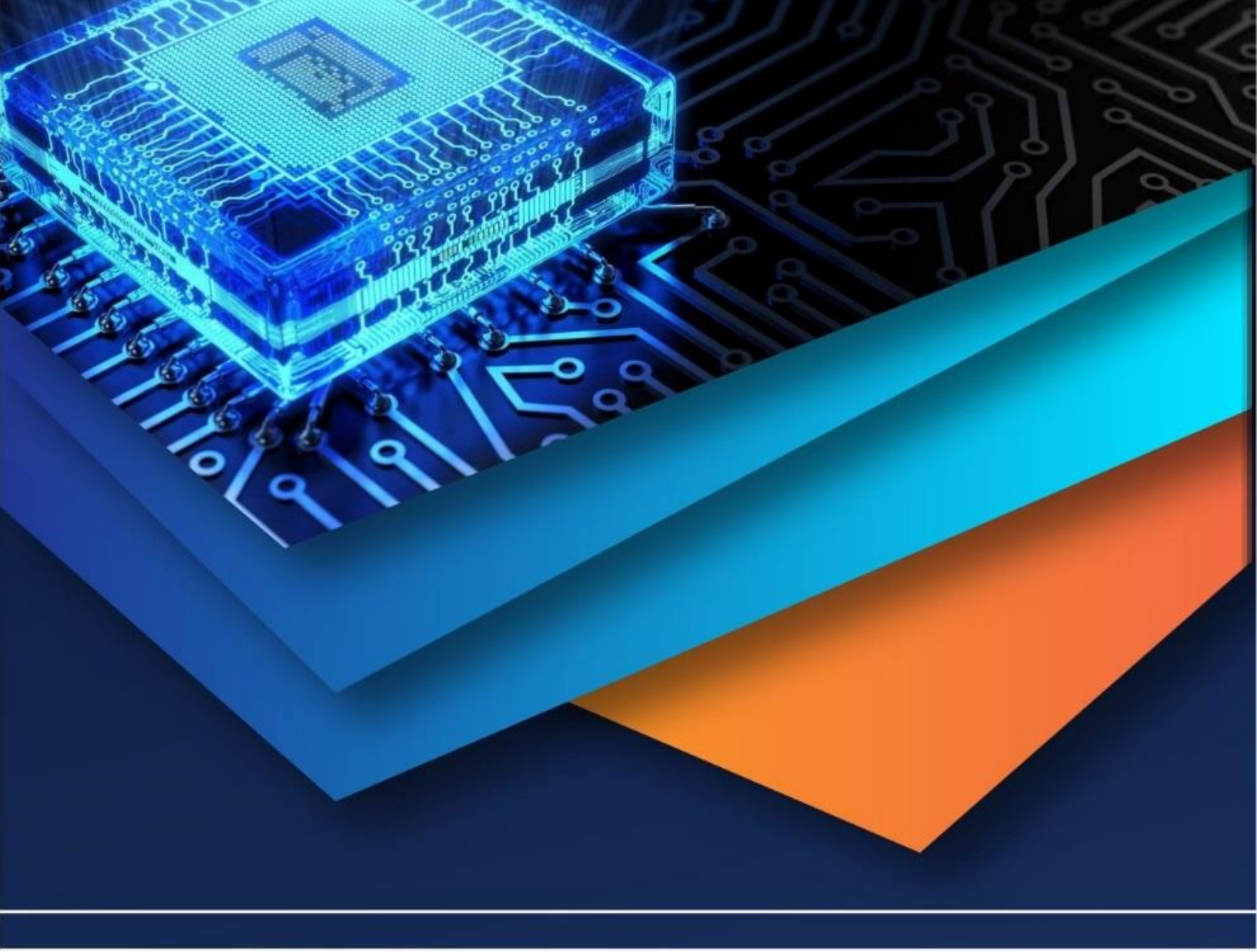

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