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Design and Analysis of Water Distribution System Using Solar and Siphon

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Abstract – *Water is very important to our life. Demand of water is always increasing with growing population. This increasing demand can be fulfilled by designing proper water distribution network based on hydraulic modelling software. In present study water distribution network of Karad region of Mhasoli is designed which is located at district Satara, State Maharashtra, India. For the design of Mhasoli village water distribution network, study of present population, population of the three decades, daily water demand, flow characteristics and also survey of the village is done with help of digital GPS. Water distribution network for Mhasoli village is analyzed and designed with the help of Bentley water-gems software. It is observed if water efficiently supply at every point with required pressure and discharge then it helps to control problems occurring against water consumption.*

Key Words*: *Water, population, water-gems, Siphon, Hydraulic.

1. INTRODUCTION

Water is most important element on earth there is no alternate of water. On earth 70% water is not used for various purpose like bathing, washing etc. only 30% water is used for our purpose, so proper water supply is necessary. To fulfil the water demand of growing population, proper pipe networking is necessary.

We know that today's several computer-based software's are used for the networking of water distribution system. In this project we use water-gems software for design a network and provide sufficient and uniform quantity of water.

In this distribution system two methods are used for supplying water by using siphon and solar system.

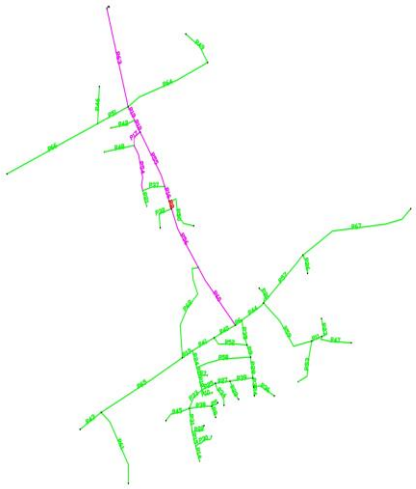


Fig -1: Network modelling through water-gems.

1.1 by using siphon:

Siphon is a long-bent pipe which is used to transfer liquid from a reservoir at a higher elevation to another reservoir at a lower level when the two reservoirs are separated by a hill or high-level ground as shown in fig.2.

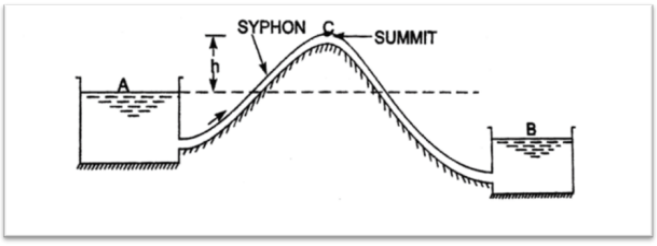


Fig -2: Typical siphon concept.

Siphon is used in the following cases:

1. To carry water from one reservoir to another reservoir to another reservoir separated by a hill or ridge.

2. To take out the liquid from a tank which is not having any outlet.

3. To empty a channel not provided with any outlet sluice.

In this research uses siphon for the case 1. Provided water with different demands and according to the population of Mhasoli village.

1.2 By using solar system:

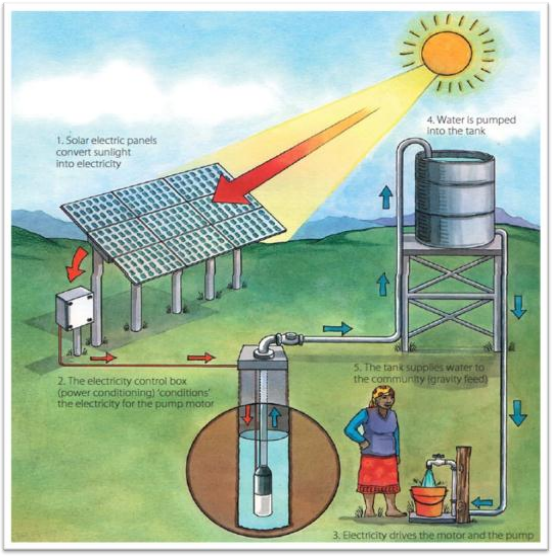
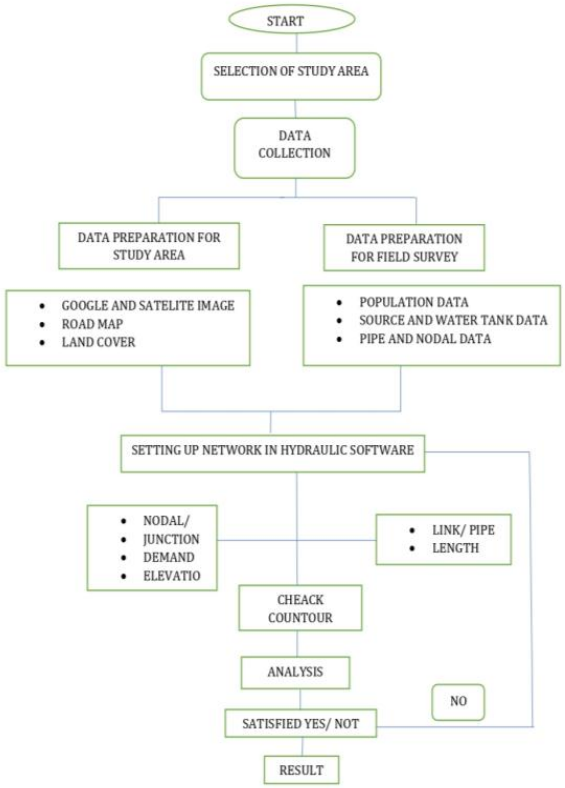


Fig -3: solar system.

1.3 layout of project:



1.4 Tank capacity:

Table -1: capacity of Tank

Detailing of Tank	Capacity	Unit
Total demand	328185	Liter
Frequency of filling water	2	Time
RCC tank capacity	164092.5	Liter
G.L of tank	680	m
Diameter of tank	2.7	m
Height of tank	3	m

2. DESIGN OF RISING MAIN:

2.1 Design of Siphon:

L=400m,

Z_A=677m,

Z_B=673m,

Z_A to summit distance, l=253m,

Height at summit =15m

D=400mm

F=0.005;

According to Bernoulis's equation,

$$\frac{P_A}{\rho g} + \frac{V_A^2}{2g} + Z_A = \frac{P_B}{\rho g} + \frac{V_B^2}{2g} + Z_B + \text{LOSSES}$$

$$\frac{P_A}{\rho g} = 10.33 \text{ atm},$$

$$\frac{P_B}{\rho g} = 10.33 \text{atm}.$$

Where,

L= Length of Siphon,

D= Diameter of Siphon,

F= Friction Factor,

Now,

$$10.33 + 4 + 0 = 10.33 + 0 + 0 + h_f$$

$$\ldots\ldots\ldots \left(\frac{V_A^2}{2g} = \frac{V_B^2}{2g} = 0, Z_B = 0\right),$$

$$4 = \frac{4*F*L*V^2}{2gD}$$

$$4 = \frac{4*0.005*400*V^2}{2*9.81*0.4}$$

V=1.98m/s

Now, $Q = \frac{\pi*D^2}{4} * V$,

$$Q = \frac{\pi*0.4^2}{4} * 1.98$$

Q=248.8 L/s,

Now applying Bernoulli's equation at summit,

$$\frac{P_A}{\rho g} + \frac{V_A^2}{2g} + Z_A = \frac{P_c}{\rho g} + \frac{V_c^2}{2g} + Z_c + LOSSES$$

$$\frac{P_A}{\rho g} = 10.33 \text{ atm}$$

$$10.33 + 0 + 0 = \frac{P_c}{\rho g} + \frac{1.98^2}{2*9.81} + 15 + \frac{4*F*L*V^2}{2gD}$$

$$10.33 + 0 + 0 = \frac{P_c}{\rho g} + \frac{1.98^2}{2*9.81} + 15 + \frac{4*0.005*253*1.98^2}{2*9.81*0.4}$$

$$\frac{P_c}{\rho g} = -30.14$$

$$\mathbf{P_c = 295.73 * 10^3 MP_a}$$

Table -2: summary of siphon

D	V	Q	$P_c/\rho g$	P_c
110	1.04	9.88	-7.26	$71.22*10^3$
200	1.4	43	-8.76	$85.93*10^3$
250	1.56	76.5	-7.30	$71.61*10^3$
300	1.71	248.8	-7.33	$71.90*10^3$
400	1.98	120.87	-30.14	$295.73*10^3$

2.2 Design of Solar:

Table -3: summary of solar

Description	Numbers	Units
Diameter of pipe	120	Mm
Velocity	1	m/s
discharge	0.0113	m^3/s
Horse power	5	K.W.
Power	3.7	K.W.
No. of solar panels	5	No.
Cost	69,750	Rs.

3. CONCLUSIONS

Water hydraulic software is an extremely powerful adopted to serve the intended purpose of this project work. The work has been designed as per guidelines and references of Indian government, by the use of water hydraulic software, the time is less required for analysing and design of networking.

The conclusion drawn based on the results obtained are presented further:

- Hydraulic programming estimates the velocity, head loss, diameter of pipes, discharge and the main network.
- According to 50 years of population forecasting the average population is 2431, and the required total demand is 3,28,185 Litre.
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- Table 6.1 represents the summary of siphon, it is found that with the decreasing in the diameter of pipe discharge also decreases, so for the suitable discharge we provide 200mm diameter for designing of siphon.
- Table 6.2 represents summary of solar, it is found that for 5Hp power it required 5no.s of 200watt panels.

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