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WATER SAVING NOZZLES AND FLOW REGULATORS

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ABSTRACT

This paper mostly comes under fluid mechanics section. This paper is generally a comparative analysis of already available technology with newly designed technology. The reason behind this study is to provide a new, cheaper, and more efficient technology of water conservation. The necessity of conducting this project is to minimize the cons of available technology. In this paper we have designed such a technology which can be used in drought challenging regions. Here we have used easily understandable concept of fluid mechanics that is ' Orifice design'

I. INTRODUCTION

Water is the most basic need of human being. Water gives life to mankind, plants, animals birds and every living creature. Sufficient, clean, and safe water is needed by everyone.

India is the tropical country where rainfall is irregular. This makes the management and storage of water a crucial part. Rapid urbanization, industrialization leads to migration of people which puts a load on sources. Due to this we are facing extreme water crisis today. But crisis is not about having too little water to satisfy needs. It is a crisis of managing water so badly, that billions of people suffer.

The supply of water and energy is one of our most critical national problems. If we cannot increase our supply, then it is imperative to reduce our consumption. Fortunately it has been proved that we can conserve dramatically and in a manner which will not seriously affect the lifestyle we are used too. Water and energy conservation are so intimately intertwined that they are practically synonymous. Any reduction in the usage of water will automatically result in a reduction of the use of energy. What this means, therefore, is that our whole philosophy on the use of water is changing and we are finally recognizing that we have been " water rich " over years and it is now time to get back to reality by adjusting to our actual needs and to practice good conservation principles.

Water if used in an unplanned manner may lead to scarcity in future and severe drought. We can see many examples of drought stricken areas in our country. Identifying losses and minimizing them as well as cutting down the water consumption may serve us from the catastrophe to come.

As water being the one of the basic needs of mankind it becomes our responsibility to conserve the sources by means of less consumption rather optimum consumption. If we cannot generate water to the level required then atleast we should minimize its consumption to the optimum level. Several countries like Australia, California have taken intiative towards water conservation. So this becomes our responsibility too to put socks on and to take the same initiative.

Several studies have been done in India under this topic of water conservation, and one of them is 'Water saving nozzles'. But from our studies and tests proved us that this technology or nozzles are not up to the mark as far as their output is concerned. So this allowed us to make something new which will be more efficient, economical and more durable.

So this paper has put forth the new invention, new technology of water conservation by reducing its consumption to optimum level i.e 'Water saving nozzles and Flow regulators'.

II. LITERATURE REVIEW

2.1 Household Adoption of Water-Efficient Equipment, The role of socio- ecological Factors, Environmental Attitudes and Policy, Authors: Katrin Millock *(paris School of economics, CNRS)*,Celine Nauges *(LERNA-INRA and Toulouse School of economics)*

Water scarcity is a global environment problem. Even countries with abutment water supply face constraints in providing clean drinking water because of water contamination from pollution that raises the costs of water treatment. Although industry and agriculture represent the bulk of water demand, the percentage of domestic use in overall water consumption ranges from 10-30% in developed countries. Given the high costs of development of new water supply projects, we observe an increased reliance on demand side management (DSM) policies, i.e, price and non-price policies designed to promote water conservation in the residential sector.

Several countries or regions have promoted rebate programs for the installation of water-efficient technologies, among them California and Australia.Several droughts between 1985 and 1992 California called for continued conservation and various measures were undertaken by local water agencies including low flow toilet rebate programs and distribution of free plumbing retrofit kits.

2.1 JOURNAL ON WATER SUPPLY (5^{TH} EDITION)**,**Authors: Don D. Ratnayaka, Malcolm J. Brandt and K. Michael Johnson *ISNB 987-0-7506-6843-9,(chapter 12: Hydaulics)*

This chapter gives the various aspects of flow of water. The concept of streamlines is most relevant to the to the idealized conditions of flow moving uniformly in a large body of water boundary is introduced into to flow the water in immediate contact with the solid surface must be stationary. Away from the surface the velocity increases up to a point where the flow is unaffected by the surface boundary. Two types of water flow are open-surface channel flow and closed conduit flow. In the former, the depth of flow can vary, in the later the area of flow is fixed and for a known flow in a given size of conduit the velocity can be calculated directly. Pipe flow is considered first as it is more straightforward. At the entry of the water into the pipe from the large tank or reservoir, the flow, as it accelerates into the inlet, approximates to the idealized condition of potential flow. However, a boundary layer is generated from the lip of the inlet and within a relatively short distance downstream of the entry expanded to fill the whole pipe.

2.3 JOURNAL ON WATER SUPPLY (6^{TH} EDITION),Authors: Don D. Ratnayaka, Malcolm J. Brandtl and K. Michael Johnson *ISNB 987-0-7506-6843-9, (chapter 13 system design and analysis)*

This chapter discusses the hydraulic system and its analysis. The geographic and physical characteristics of an area influence the layout of a system. An interconnected looped layout that enables water to flow in multiple paths to any part of a network provides maximum flexibility. Urban systems tend to comprise looped networks, albeit that the network is subdivided into hydraulically discrete areas for leakage and demand management.

Dendrite (tree like) layouts are more common for trunk mains and local distribution in rural areas. The most economic layout for a system is one of that is gravity fed from a local service reservoir located as near as technically feasible to the distribution area it serves.

Mathematical models can be used to analyze the hydraulic performance of existing trunk mains distribution pipe work, to design new networks and to assess system operational performance under the variety of supply and operating conditions. A detailed hydraulic analysis can define both the physical pipe performance and design parameters, control regimes for pumps, control valves and storage, establish and determine the behavior of reservoirs, their inlets and outlets and the effects of a burst main or major fire demand. However the modeler should always remember that the accuracy of a model is no better than the quality and availability of the data from which it is developed. Confidence in the results require a corresponding confidence in the input data especially for estimated nodal demand.

III. RELEVANCE OF WORK

As we know the demand of water is much greater as compared to supply from the sources. Hence it is necessary to use water very carefully and try to as much as we can. The water saving nozzle exactly does the same. According to preliminary study excess of water is used for flushing, washing, bathing, in kitchens etc. Suppose in 7 storey building if water supplied by ordinary tap is about 30 liters per minute on the other hand water supplied by the water saving nozzle allows only 3 to 5 liters of water per minute. Thus we can save 50-60% of water.

1. Save the water resources and increase the amount in water scarcity areas for people.
2. Reduce the water abstraction.
3. Ensure the habitats and the living conditions of plants and animals who are dependent on wet areas.
4. Save energy for abstraction and allocation of water.
5. Reduce materials for the supply network and for the sewer networks.
6. Minimizing the costs and the efforts for treating the outgoing wastewater.
7. Reduce monthly expenses on water bills.

IV. METHODOLOGY

4.1 Selection of 4 storey residential building

we have selected a 4 storey residential building naming ‘Radha Krishna Complex’ located in miraj city consisiting of two parallel water supplying lines. The building consists of 1 BHK 8 flats.

Building specifications:

- 2 parallel water supply lines
- ½ inch GI pipe system
- 5000 lit overhead tank

4.2 Selection of water supply lines for installation of nozzles

There are two parallel pipes supply line 1 & supply line 2. Out of these supply line 2 is selected to test nozzles which are available in market and supply line 1 is used to design new nozzles.

4.3 Discharge measurement using 2 liter measuring cylinder for water supply lines 1 (lit/min)

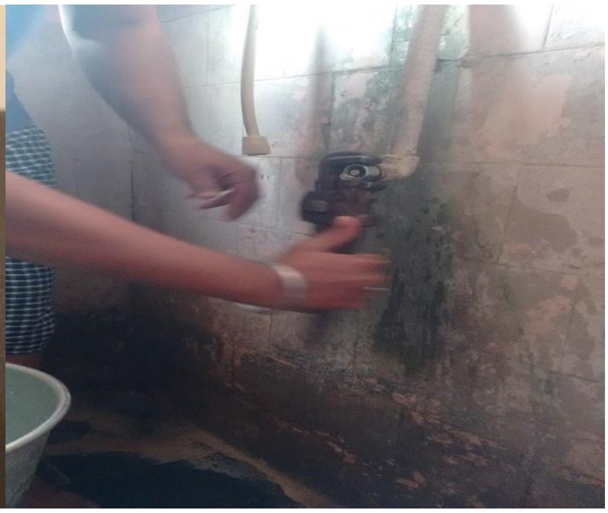
For the measurement of discharge, the materials used are 2 lit measuring jar, timer set to 1min and a bucket to collect discharged water. The discharge data which we have got is as mentioned in the table below:

Floor	G.F	1^{st} Floor	2^{nd} Floor	3^{rd} Floor
With Tap	14	12.5	8.5	6
Without Tap	36	31	27	24.5

Here we can observe that there is the decrease in the discharge output as we move upward. The discharge values are in descending order from G.F to 3^{rd} floor.

4.4 Installation of readymade nozzles for water supply line 2.

The purchased nozzles are of 5 lit/min capacity. Three nozzles have been installed per floor each.

4.5 Measurement of discharge efficiency for readymade nozzles.

The installed nozzles were tested for their output efficiency. After analysis we found that they vary with their discharge output for which they are meant to be i.e 5 lit/min. we found the decrease in output from G.F to 3^{rd} floor. The discharge outputs per floor are as mentioned in table below:

Floor	G.F	1^{st} Floor	2^{nd} Floor	3^{rd} Floor
With Nozzle	5.0	4.9	3.9	3.5
Without Nozzle	21.3	17.5	12.5	10.8

4.6 Pressure measurement for each floor using pressure guage.

Here for pressure measurement over each floor, we used a water pressure guge of capacity 7kg/cm2 and an assembly consisting of APVC cut pieces and a T joint.

Obtained pressure values are as follows:

Floor	Kg/cm2
G.F	1.15
1st Floor	0.95
2nd Floor	0.60
3rd Floor	0.45

4.7 Head measurement from calculated pressure data

The pressure reading which have already been collected are used to calculate the water pressure heads for corresponding floor. The formula used is as follow:

$$\mathbf{P = \rho g h}$$

Where p = water pressure at the floor

ρ = density of water

g = acceleration due to gravity

h = water head

Floor	Head (cm)
G.F	1.17
1st floor	0.96
2nd floor	0.61
3rd	0.45

4.8 Installation of test nozzles

Here, we have used 5 tests nozzles with inner diameter (d2) as 2mm, 4mm, 6mm, 8mm, 10mm.

4.9 Finalizing actual nozzle diameter corresponding to predetermined discharge.

Each nozzle has been tested for every floor in order to achieve the discharge data per floor so as to achieve a relation between inner diameter of nozzle and discharge. Further the discharge is plotted against d2 in the form of graphs for each floor and the corresponding diameter for a nozzle representing a discharge of 5 lit/min same as readymade nozzle for each floor is found out. The formula which is used for the calculation is as follow:

$$Q = a1.a2.(2g.h)^{½} / \{[a1]^2–[a2]^2\}^{½}$$

Where:

a1 = Cross section area of pipe at inlet i.e. entry section.

a0 = Cross section area of Orifice.

h = Pressure head difference in terms of fluid flowing through pipeline system.

The discharge readings for test nozzles are as follows:

Floor	2mm	4mm	6mm	8MM	10MM
G.F	7.00	10.6	18.7	23.5	28
1st	6.6	8.2	14.1	18.0	22
2nd	5.5	6.4	11.4	17.1	19.1
3rd	4.9	5.7	10.2	15.8	18.3

V. RESULTS

1. The data which we have obtained for the discharge outputs of tests nozzles, we have plotted a graph representing inner diameter of nozzles (d2) vs discharge output. the graphs are as follows:

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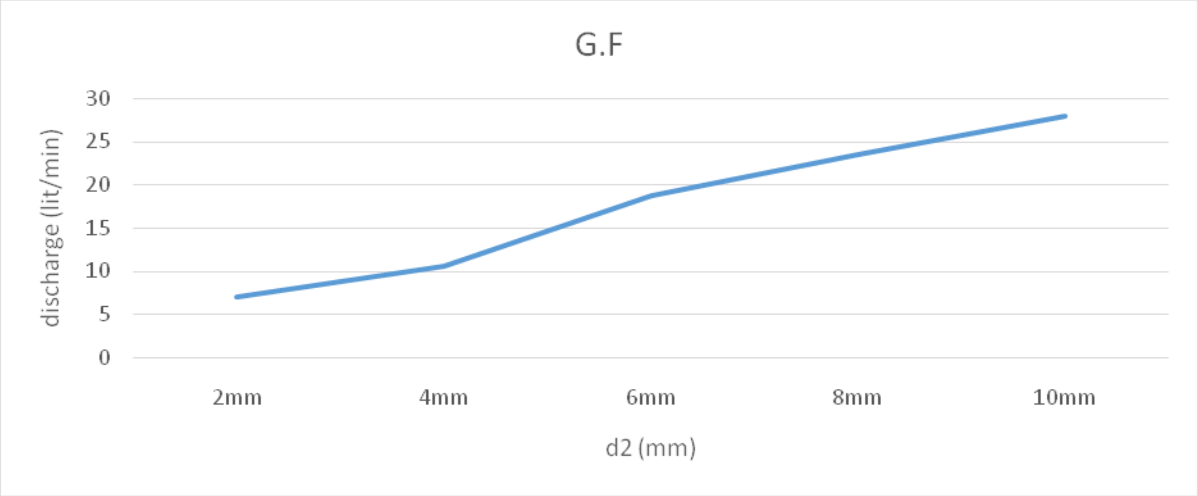

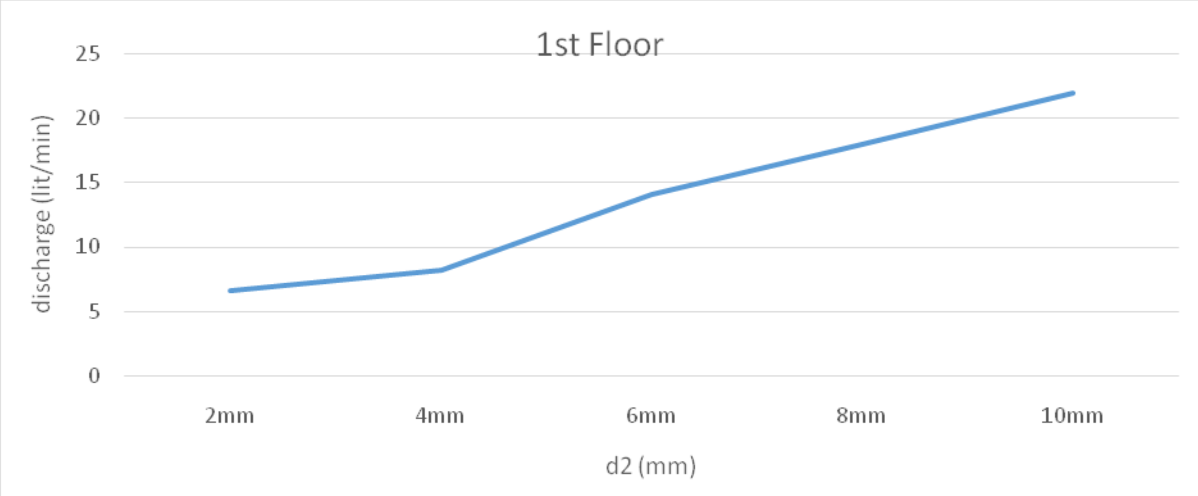

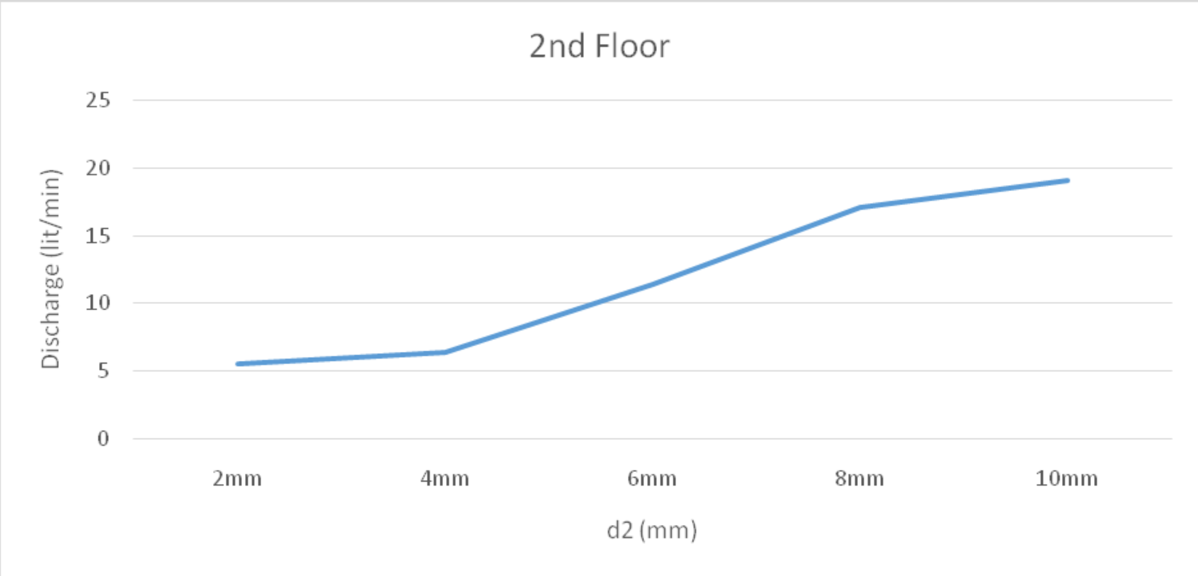

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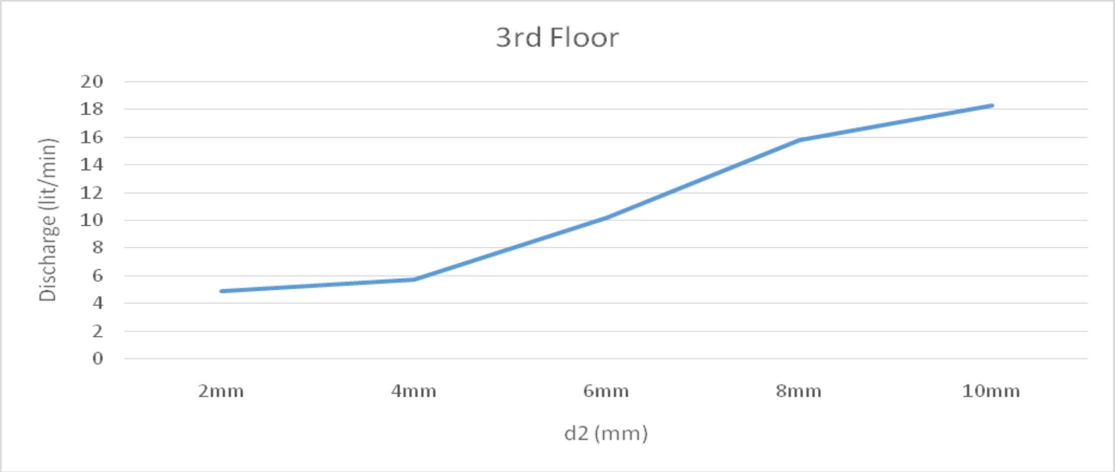

Here we can design a nozzles with inner diameter d2 for any predetermined discharge for corresponding floor. e.g suppose we want to design a nozzles with 15 lit/m discharge output for G.F then from the graph for G.F we will get the value for d2 for 15 lit/m discharge as 5.15 mm.

2. Cost Comparison

The market available readymade nozzles will cost between Rs.500-600/nozzle. The nozzles which we have designed will cost Rs.150/nozzle including manufacturing and profit.

3. Material used

The market available nozzles are made up of stainless steel material while newly designed nozzles are made up of cheaper material i.e hard nylon.

VI. CONCLUSION

1. The new nozzles are more cheaper than the market available nozzles.
2. New nozzles can be designed for any predetermined/required discharge output.
3. Both the nozzles have good resistance for high temperature i.e they do not alter in their shape and size even though used under hot water.

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