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Approches for Improving Water Efficiency for Buildings

Kishori Sutar
Student, Department of Civil Engineering, Sinhgad College of Engineering, Pune-41, kishorisutar20@gmail.com

S. S. Shastri
Head of Civil Department, Sinhgad College of Engineering, Pune-41, ssshastri.scoe@sinhgad.ed

Mayawati Fule
Student, Department of Civil Sinhgad College of Engineering ,Pune-41 mayurafule@gmail.com

V. S. Limaye
Associate professor, Dept.of Civil Engg.Sinhgad College of Engg, Pune- 41 vslimaye.scoe@sinhgad.ed

Abstract — In India water usage for commercial, residential, institutional building etc, is increasing day by day. Also because of changing habits of the users there is tremendous pressure on municipal co-operation. The increased demand is responsible for more wastewater generation, having negative impact on environment. Hence increase in water efficiency by integrating appropriate methodologies would suffice the associated problem.

A smart user in the city is armed with elementary infrastructure to give a decent quality of life, a clean and ecological environment through use of some smart solutions. However with awareness amongst the people and the policies of new government for Swachchha Bharat Abhiyan, the sanitation component in the rural areas is also gaining lot of attention.

After studying the feasibility and effectiveness of many methodologies, a prosperous solution for reducing the pressure on municipal co-operation in an integrated way, in turn would be effective for smarter buildings and hence the cities.

Keywords: water efficiency, smart buildings /city, integrated way.

I. Introduction

The life on earth is dependent on air, soil, water primarily. The increase in population, industrial growth & change in habits of users are responsible for water scarcity. The global climate change has depicted decrease in rainfall intensity as well. Hence there should be positive lookout for improving the status of air, soil and water.

Efficiency helps in controlling rising water Bills, reduce environmental footprints and increase the value and competitiveness of buildings.

II. Water Efficiency Defination

- Water efficiency means using improved technologies and practies that deliver equal or better service with less water. (USEPA)
- An indicator of the relationship between the amount of water required for a particular purpose and the amount of water used or delivered (LEED India)

NEED OF WATER EFFICIENCY:

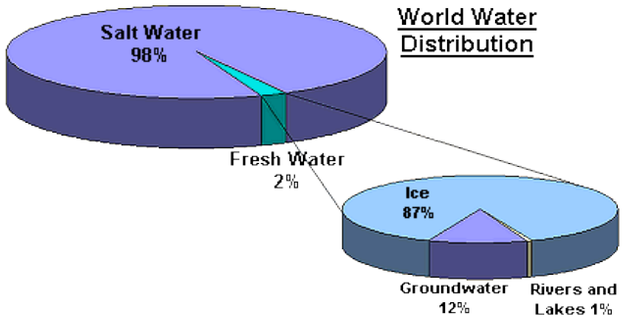

Fig. 1. World Water Distribution

Source: **(**Gleick, P. H., 1996: Water resources**)**

As above figure 1 shows 98 % water is saline and 2% of water is freshwater. 87 % water from freshwater category is in the form of ice, 12 % of water is groundwater, and in rivers and lakes only 1% of water is available. Increasing population, urbanization, industrialization and changed habit of population are responsible for increased water usage and wastewater generation. Wastewater creates large impact on environment, hence it is necessary to do water conservation and water saving by using various techniques.

III. Techniques for Increasing Water Efficiency

Water Efficiency can be increased by the following techniques:

i) Dual Flush Toilets
ii) Waterless urinals
iii) Censored Smart Taps
iv) Recycling and Reuse of Wastewater

a) Dual Flush Toilets

Dual flush toilets have ability to flush at full volume or low volume. Users can select the full volume flush to flush the fecal matter and low volume for urine discharge. The conventional flushing tank is of 14 liters capacity in female washrooms. So, every flush costs 14 liters of water irrespective of the waste (fecal matter or urine matter). Most of the dual flush toilets use 6 liters for the full volume flush and 3 liters for low volume flush.

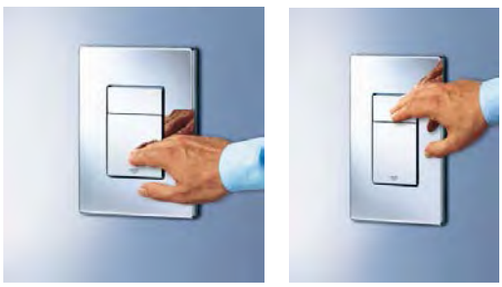

Fig. 2. Dual Flush Toilets

Source: (Azure.com)

Analysis & Results

In this techniques we have taken readings for Civil Department by considering 6 lit. & 3 lit. Water used by dual flush toilets. and conventional flush tank uses the 10 lit. of water per flush.

TABLE1: WATER USAGE STATISTICS PER HOUR

Western toilets system calculation					
Civil Dept. (for Ladies toilet)					
Locations (1)	**Volume of flush tank (L) (2)**	**No. of users (3)**	**Water usage by Western toilet(L) (4)**	**Water usage if dual flush system is provided (L) (5)**	**Possible water saving (L) (4)-(5**
Ladies Toilet	Nuline 10 L	10	10*10=100	10*3=30	100-30 = 70
		12	120	36	84
		14	140	42	98
TOTAL			360 L	108 L	252 L

b)Waterless Urinals

Waterless urinals do not require water for flushing and thus result in saving in large amount of water per year. Waterless urinals don't have odor problem. Yearly billions of liters water used by conventional urinals in India. Conventional urinals use large amount of water for flushing, so generation of wastewater is more and treatment cost also increases. Scale formation causing blockages in drainage lines due to use of hard water for flushing urine. Conventional urinals have odors problem.

In Civil Department of Sinhgad College of Engineering, the waterless urinals are installed for water saving purpose in year 2014. The project compares the conventional urinals and waterless urinals installed in Biotechnology Department and Civil Department of the same Institution. The strength of Gents in the Civil Department (including staff) is 859 and of Biotech Department is 80.

Table II: Water Usage Statistics for One Peak Hour

Date	**No. of users per hour**		**Conventional urinals Biotech Dept. water usage in** lit.	**Waterless urinals Civil Dept water saving in** lit.
	Civil Dept.	**Biotech Dept.**		
1/2/ 2016	42	15	82.5	231
2 /2/ 2016	45	17	93.5	247.5
3/2/2016	39	14	77	214.5
Total			253 L	693 L

Calculations for Conventional Urinals Flush Tank

Measurements of flush tank are taken by tape and water storage capacity is calculated and also by using 4 liters bucket it is verified .

Fig. 3. Flush tank of conventional urinals

L1 = Top length of flush Tank
L2 = Bottom Length of flush Tank
H = Height of flush Tank
W1 = Top width of flush tank
W2= Base width of flush tank

L1= 30cm, L2= **27cm,** H= **15cm,** W1= **14cm,** W2= **12cm**

Using Trapezoidal formula,

Volume of flush tank = L*H*[(W1+W2)/2]

$= 5.556* 10^{-3} m^3$

≈ 5.5 liters. **OR**

By using bucket method: 4 liters of bucket were used = 4+ 1.5 L= 5.5 L.

Costing for Waterless Urinals

As per Shashwat Eco- Foundation Pune, costing for one urinal block for one floor building is,

TABLE III: COSTING OF WATERLESS URINAL FOR ONE URINAL BLOCK

Sr.no	Parameters	Unit Rate	Quantity	Cost
1	One cartridge cost	550	3 per year*	1,650
2	Plumbing Charges	-	3	3,500
3	Consultation & supervision charges including travels & communication	-	-	2,000
4	Service tax@ 14%			280
5	Total			7,430/-

c) Censored Smart Taps

These taps are water saving taps, these can be provided at the any kind of buildings. These taps should also cut off water supply when the hands are removed from under the tap.

Figure 4 Sensored Smart Taps

Source: (California Energy Commission)

Work on censored Smart Taps are in progress

d) Recycling and reuse of wastewater

There are various treatment methods for the treatment of wastewater. Some of them are required energy, some of them required land, and some of required proper maintenance. There are various techniques which require very less energy and maintenance. By using such low cost treatments like rootzone system, waste stabilization tank,duckweeds etc the campus wastewater was treated. The main focus is on rootzone technique.

Rootzone system*:* it is wastewater treatment techniques, This techniques is used as clean-up technology for wastewater. In this technique green plants including grasses and woody species to remove various contaminates from soil and water. Rootzone techniques having filter beds of sand , gravels and soil etc. The biofilm form at the top of bed and it act as a filter. This technology uses natural way to effectively treat the wastewater.

Advantges of rootzone system

- Complete biological and eco friendly method of treatment.
- No foul odor is released
- Construction, maintenance& operation cost is low.
- Least consumption of electricity and asthetically looking better.

The further work is going on regarding to the provision of root zone technique for the treatment of grey water for the departmental wastewater treatment. The treated water is used a flushing water, horticultural purpose etc.

Proposed Work

The project tries to focus on 4 major technologies to reduce the water usage in the institutional buildings. The techniques are as follows:

1. Waterless Urinals
2. Dual flush toilets
3. Censored Smart Taps
4. Recycling and reuse of sewage water.

Work on censored smart taps and recycling and reuse of wastewater is in process

IV. CONCLUSION

- The statistical observation indicated, clearly denotes the saving range per hour for 3 days total water saved by waterless urinals is 693. For 859 Population count in Civil Engineering Department.
- The statistical observation indicated also specifies the usage range 253 L. for 80 Population count in Biotech Engineering Department.
- Large amount of water can be saved by dual flush toilets if it is provided.

REFERENCES

[1] B.E. Perdue, D. Freeman, G. Hunt, T. Reeder “water efficiency manual for commercial, industrial and institutional facilities” Division of Pollution Prevention

and Environmental Assistance and Division of Water Resources of the N.C. Department of Environment and Natural Resources, and Land-of-Sky Regional Council, may 2009.

[2] R.K. Trivedi, (2007). Low cost and energy saving technologies for water and wastewater treatment. journal of industrial pollution control , 403-411

[3] “Green Building Design Guide”