

INNOVATIVE LOW COST AND WATER EFFICIENT SUSTAINABLE TOILET-BATHROOM FOR RURAL AREA

Pruthviraj Patil¹, Vinshree Jadhav², Radhika Kolap³ and Prof. Pravin Manatkar⁴

^{1,2,3}U.G. Student, Trinity Academy of Engineering Pune Maharashtra, India

⁴Faculty Trinity Academy of Engineering Pune, Maharashtra, India

Abstract: The project deals with construction of low cost toilets in Rural areas. It includes construction of bathrooms and water closet together. The water we used for washing clothes or bathing is recycled by using filter media and is further reused for flushing in toilets which will decrease water consumption. The components like wall, roof will be constructed using some different material like bamboo which will decrease the cost of construction. The total project will generate zero waste and will not require any energy from outside at the time of its actual use. All the components of this project are precast and will not require any energy from outside at the time of its actual use.

1. INTRODUCTION

In our country there are almost 524 million people are defecate in open area and the rural women faced hardship due to lack of secure bathing space with the access of water. If water is life, sanitation is most likely a 'lifecycle' and access to such a provision affects the nature of human life and wellbeing. An all encompassing meaning of sanitation incorporates safe drinking water, fluid and solid waste administration, natural cleanliness and individual cleanliness. Rural sanitation in india is a subject of primal concern and among the top agendas of government of india for the development of nation. There are economic losses due to lack of sanitation, health aspects, aesthetic appearance.

In 1980 rural sanitation coverage was estimated at 1% and it reached 95% in 2018. In rural regions in 2012 there were almost 59.4% households with no toilet and the number drop to 28.7% in 2018. Since present day there are many rural regions in country which households has no toilet. But by observing above numbers it has been seen that there will be growth and development in sanitation which will booze the development of the Nation.

The construction scenario in rural areas of India is such that materials like cement and steel has high impact as the structure built of cement and steel have long life span but it has detriment that it increases the overall cost of construction. From beginning to completion of structure energy is highly used by cement and steel. Bamboo is searched material which almost can give same result as steel and cement.

The issue of greywater management which is defined as all sources of domestic waste water is gaining more and more importance. Greywater management is not only a precondition for clean and healthy living but also has a great potential for reuse. Using greywater for toilet flushing is best practice. Proper Greywater treatment can leads to effective and efficient use of it in toilet flushing.

2. LITERATURE REVIEW

1. Performance of Greywater treatment plant by economical way for Indian rural development. (By Saroj B. Parjane, Mukund, G.Sane):

In this paper laboratory scale greywater treatment plant design, it is the combination of physical and natural method such as aeration, agitation, primary settling with cascade water flow and filtration are concluded. In this greywater reuse system is developed. This is cost effective process. This treated greywater is reuse in toilet flushing, cloth washing, irrigation purpose.

2. Greywater treatment in sand and gravel filter. (By Lukas Huhan, Stefan Deegener, Rostom Gamisonia):

In this study the various filtration techniques are given that is vertical greywater filter, horizontal filter, bio filter. In vertical filter the surface should not be more than 2.5 m² and 8-20, 0-4 mm size of gravel and sand are used. In horizontal filter the size of stones (50-100mm), coarse gravel (10-30 mm) and wash gravel (6-10 mm) are used. In bio filter natural material like straw, bark, wood chips are used to treat greywater. In this two chamber system with inlet pipes are reconstructed.

3. Research and development on bamboo reinforced concrete structure (By Masakazu TERAJ and Koichi MINAMI):

This paper investigates the mechanical properties of bamboo reinforced concrete structure. It compares these experimental results of bamboo reinforced concrete members with the experimental one of reinforced concrete members, and the mechanical property of the bamboo reinforced concrete members is studied. From these experimental works, the probability of effective use of bamboo is discussed.

4. Bamboo as a cost effective building material for rural area (By shwetapatil, shrutimutkekar):

The main focus of this paper is to promote the use of bamboo as cost effective material. The present paper suggests the use of bamboo in combination with modern material technology as a building material in rural construction.

5. Study on a stepped eco-filter for treating greywater from single farm household (By Jianjun Chen, Zaiyi Liao, Shanyong Lu, Guangcai Hu, Yaixin Liu, Cilai Tang)

This paper aimed to investigate the hydraulic loading rate for the optimal removal efficiency and to analyse the processing and performance throughout an entire year. The results showed that, the average value of TP. From the influent was much lower while the linear alkylbenzene sulfonate was a little higher compared to other related studies. The average system removal rate in summer were all higher than in winter. Together with the good performance, advantaged of lower cost and easier maintenance, this process has shown good capability for greywater treatment in rural area.

6. Development of water saving using toilet flushing mechanisms (By Roubi A. Zaied)

In this paper two trial approaches for flushing system design. The first one employs a rotatable blade in the bottle of the bowl. The second approach depends on using a rotatable trapway such that it can be tilted down to enable discharging materials in the bowl directly by its gravity. This study can help more to design better water saving systems.

3. METHODOLOGY

PART I

By study of above research papers we found different low cost materials like bamboo for construction of toilet bathroom in rural area and filter media for treating grey water in bathroom. Treated grey water used for flushing purpose of toilet.

The national democratic alliance government in 2014 by launching the swachh bharat mission had set a target of making rural areas open defecation free. More than one-fourth of households in villages have no access to toilets according to the latest official survey conducted by the national statistical office.

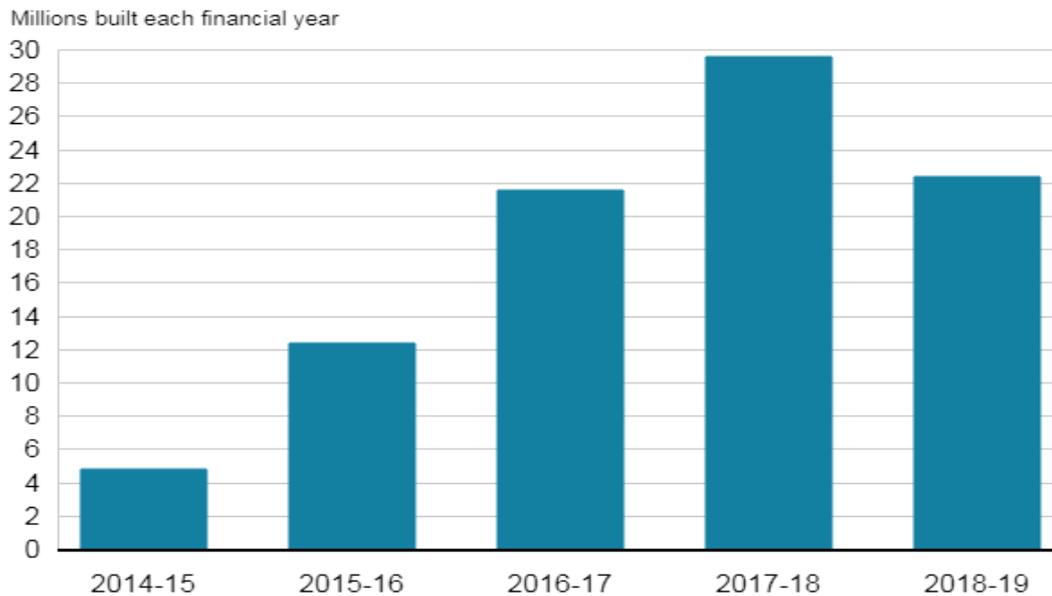
We find out basic information about toilets provided in rural area Table 1 shows rural households with no toilets.

Table 1: Rural households with no toilets.

State	Percentage
Odessa	50.7
Uttar Pradesh	48
Jharkhand	41.9
Tamilnadu	37.2
Bihar	36.2
Rajasthan	34.2
Karnataka	30.1
Maharashtra	16

(Source: National Statistical Office report 2018)

Table 2: Toilet construction in rural india



(Source: National Statistical Office report 2018)

PART II

By the study of above research paper, we decided to use bamboo reinforcement as a replacement of steel reinforcement. Bamboo is naturally available and sustainable material and it can be use as a building material because of its satisfying and favorable properties. Bamboo can withstand dead load, live load, wind load, snow load etc.

Walls, Slabs of Toilet-Bathroom are constructed of bamboo reinforcement instead of bricks which leads to cost reduction of Toilet-Bathroom.

Benefits:

- Bamboo is cost effective than bricks.
- Bamboo is naturally available and sustainable building material.
- Low cost Toilet-Bathroom is our objective and it can be achieved by using bamboo.
- Bamboo is extremely lightweight and strong fibre.
- Bamboo is long lasting which leads to long life span of the structure.





PART III

Waste water contains greywater, blackwater and yellow water. Greywater is gently used water from your bathroom sinks, showers, tubs, and washing machines. It may contain traces of dirt, food, grease, hair and certain household cleaning products.

Characteristics of Greywater:

- Microbiological – Lower levels of thermotolerant coliforms.
- Chemical – Soap, Shampoo, hairdyes, toothpaste and dening chemicals.
- Biological – Lower levels of concentration of biochemical oxygen demand.
- Physical – High in suspended solids, hair and turbidity.

Filter to treat grey water:

The Filter contains sand, charcoal carbon and Gravel as filter media. Tray system is provided in the filter as the filter medium layers are provided with trays and it is beneficial as there is no need of back washing it can be done by removing trays from filter, clean them and place them again in filter.

Location of filter:

The filter is located on ground under the bathroom, as bathroom is lifted up for about 1 meter from the ground.

Dimensions of Filter:

(Length x Width x Depth) 1000 x 1000 x 800 mm.

Storage tank is also provided under filter of size 300 mm to collect the filtered greywater.

Layers of Filter Media:

- 1) Sand Layer- The size of sand layer is 200 mm. It decreases number of bacteria and removes most of the solid particles. It eliminates suspended matter, as well as floating and sinkable matter.
- 2) Charcoal Layer- The size of charcoal layer is 200 mm. Charcoal is most efficient material for removing volatile organic compound. It removes toxicants from grey water.
- 3) Gravel Layer- The size of gravel layer is 200 mm. Gravel stones has capacity to hold back precipitates containing impurities.

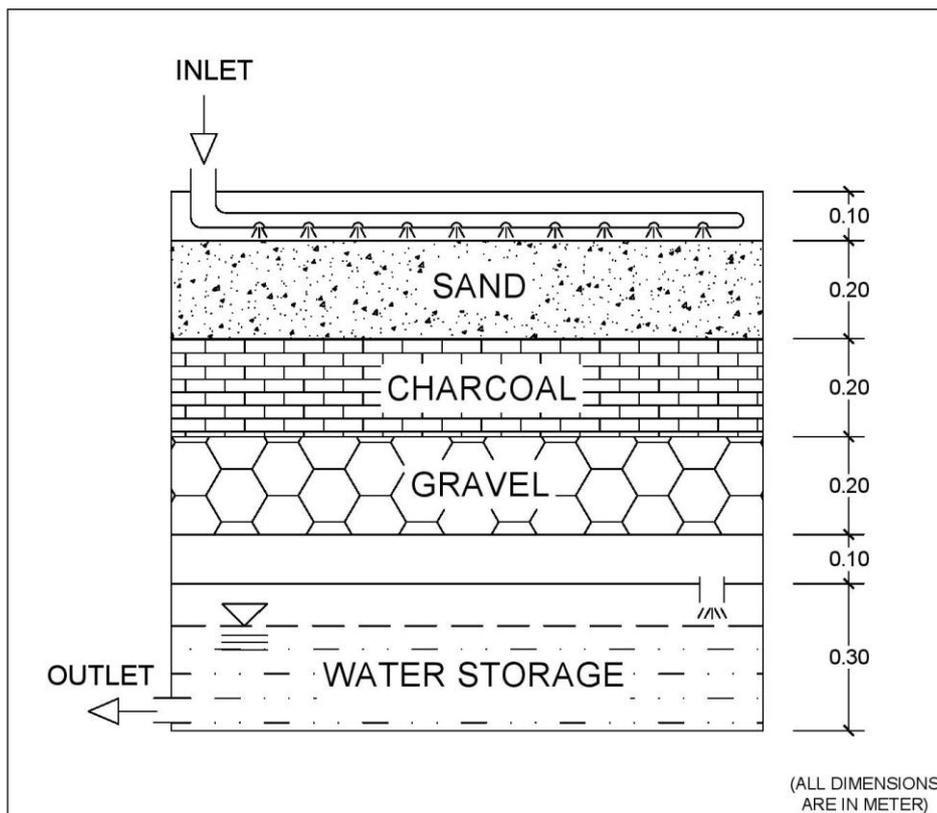


Fig No 1: Section of Filter

3D View of Toilet-Bathroom:



4. CONCLUSION

Accomplish economy and development of rural area is the major factor consider in this project. This project provides sustainable and ecofriendly Toilet-Bathroom for rural area. Hence by doing this project we can fulfil some objectives of “SWACCH BHARAT” mission.

REFERENCES

- [1] “Low Cost Technology Options for Sanitation in India as per the Demand of the Local Surrounding”, 2013. Centre for Civil Society, 307.
- [2] Masakazu TERAJ & Koichi MINAMI, 2012. “Research and Development on Bamboo Reinforced Concrete Structure”.
- [3] Shweta Patil, Shruti Mutkekar, 2014. “Bamboo as cost effective building material for rural construction, Journal of Civil Engineering and Environmental Technology”, 2349-879X.
- [4] Jianjun Chen, Zaiyi Liao, Shaoyong Lu, Guangcai Hu, Yaixin Liu, Cilai Tang, 2017. “Study on a stepped eco-filter for treating greywater from single farm household”, Apply Water Sci, 10.1007/s13201-017-0536-2.
- [5] Ruchi Mehta, Prof. Balazs Fekete, “Research term paper on grey water”, The city college Newyork.
- [6] Prathapar, S., Jamrah, A., Ahmed, M., Al Adawi, S., Al Sidairi, S., Al Harassi, A., 2005. Overcoming constraints in treated greywater reuse in Oman. Desalination 186, 177-186.
- [7] O’Toole, J., Sinclair, M., Malawaraarachchi, M., Hamilton, A., Barker, S.F., Leder, K., 2012. Microbial quality assessment of household greywater. Water research 46, 4301- 4313.
- [8] Sahar Dalahmeh, 2013. “Bark and Charcoal Filters for Greywater Treatment”, Pollutant Removal and Recycling Opportunities, Doctoral Thesis Swedish University of Agricultural Sciences Uppsala. ISSN1652-6880
- [9] Sam Godfrey, Pawan Labhashetwar, satishwate (2009), “Grey water reuse in residential schools in Madhya Pradesh, India- A case study of cost- benefit analysis”, Elsevier journal Resources conservation and Recycling, 53, (2009), pp287-293.
- [10] <https://www.bbc.com/news/world-asia-india-46400678>
- [11] https://www.business-standard.com/article/economy-policy/rural-india-open-defecation-free-not-quite-shows-nso-survey-report-119112400603_1.html
- [12] Amit D Chougule, Manoj H. Mota, Ushadevi S Patil, 2015. “To Study the Filler Slab as Alternative Construction Technology - A Review”, Journal of Information, Knowledge and Research in Civil Engineering, Volume: 3.
- [13] “Environment Friendly Indian Building Material Technology for Cost Effective Housing”, Society for Excellence in Habitat Development, Environmental Protection & Employment Generation (SHEE).
- [14] “Eco Toilets,” January 3, 2013. http://www.gramalaya.org/eco_toilets.php
- [15] Tyagi, Anupam.2012.” India – Government funds for sanitation inadequate, private sector should pool in”. The Economic Times, February 9, Health Care Section.
- [16] Tanushree Bhattacharjee, Prof. Milind R.Gidde , Dr.Bipinraj N.K., 2013. “Disinfection of Drinking Water in Rural Area Using Natural Herbs”, International Journal of Engineering Research and Development, 2278-067X
- [17] <https://www.ecoideaz.com/innovative-green-ideas/low-cost-water-filtering-ideas>
- [18] Ekta Bagde, Aditya Kuthe, Praful Wanjari, MitaliKharbade, Prof. Jayant Dorve, 2018. “LOW COST WATER PURIFIER FOR RURAL AREAS”, International Research Journal of Engineering and Technology (IRJET), 2395-0056
- [19] Vijaya V. Shegokar, DilipS.Ramteke and Pravin U.Meshram, 2015. “Design and Treatability Studies of Low-Cost Grey Water Treatment with Respect to Recycle and Reuse in Rural Areas”, International journal of current microbiology and applied science, 2319-7706 Volume 4 Number 8
- [20] <https://www.thebetterindia.com/13532/biosand-filters-providing-clean-drinking-water-remotest-areas-india/>