Efficient Water Management in Residential Building at Kolhapur

Saba Riaz Lad [1], Anjali S. Jadhav [2]

[1] Assistant Professor, School of Architecture, D.Y. Patil College of Engineering and Technology,
[2] Professor, SPSMBH's College of Architecture,
Kolhapur, Maharashtra, India.

Published in IJIRMPS (E-ISSN: 2349-7300), Volume 11, Issue 4, (July-August 2023)

Abstract
Every drop of water continually circulates through the air, land, and sea before being used by something or someone. This is known as the "Creation through water." Rainfall, groundwater, surface water, and recycled water are the only sources of freshwater at city level. We can ensure that there is enough water for all of the planet's living things to share by utilizing it more wisely. Water must be conserved, stored, and used again. Global climate change has an impact on the water scenario. There are many different residential societies, apartments and complexes in India as a result of changing lifestyles brought on by urbanization and metropolitan population growth. Kolhapur city is in a very precarious situation in case of a water scenario because of excessive demand, significant wastage, inadequate management of water, unplanned digging of bore wells, significant fluctuation in temperatures and huge floods in previous years. In order to catch the water from the natural sources, traditional restoration and ground water recharge technologies can be easily adopted. To get drinkable water, rainwater harvesting may be done on a domestic scale.

Waste water consists of grey water and black water. Grey water may be cleaned up and utilized for non-potable purposes like flushing and gardening. On a wider scale, black water can be dumped straight into a septic tank or sewage treatment facility, which purifies the water and allows it to be used for non-potable uses. To reduce water usage and help with water and electricity bill reduction, water-efficient fixtures can be installed. Reusing treated water lessens the demand on centralized sewage treatment facilities while also reducing the requirement for fresh water. Dual piping systems may be modified for existing residential buildings to provide for a smooth passage of both grey and black water separately. A residential complex may simply regulate water consumption properly by educating inhabitants.

Keywords: Rainwater Harvesting, Grey Water, Black Water, Water Management

1. Introduction

The world is now experiencing a historic water crisis as a result of excessive usage and increased demand (Loomis, 2014). A healthy human existence requires clean freshwater, but 1.1 billion people have zero access to it and 2.7 billion withstand a minimum of a month of the year without access of

water (Sharman, 2010). Environmental considerations are important for the next generation. The entire amount of freshwater that is accessible on Earth is insufficient to meet human needs. At the moment, around 800 million people experience water stress, and it is predicted that by 2025, this figure would rise to 3 billion (Hanjra, 2010) (UNDP, 2017). Biological survival is the primary driver of water usage and its related uses, whereas housing requirements, food production, and other developmental requirements are the others. The National Commission for Integrated Water Resource Development Plan predicted a total water demand of 1180 billion cubic meters, up from 710 in 2010. Due to the changing climate, floods, unusual heavy rains, pollution, rising population, and water waste, Kolhapur city has to manage its water resources wisely and sustainably (WHO, 2006). However, from the standpoint of residential complexes and communities, managing waste water and rainfall involves little work compared to other approaches and strategies.

2. Efficient Water Management in Residential Buildings at Kolhapur

The proficient arranging, advancement, dissemination, and organization of water assets is known as water management. Securing this valuable asset by moderating water in our possessed homes by utilizing constrained sum of water when vital. This makes each citizen at risk for any squander that gathers. A few benefits of water management in residential buildings are as mentioned below:

- Adequate water management will lead to put down water bills as less utilization of water will diminish wastage of water
- Productive water administration can anticipate the dams to flood and cause flooding as confronted by the inhabitants of Kolhapur in past years.
- Put away water can offer assistance amid hot summer days
- Diminish wastage of vitality
- Diminish water contamination. Subsequently, minimizing wellbeing dangers
- Less hurt caused to the oceanic life
- Advantageous to both the communities and government
- Water will be spared for future era
- It will lead to economical approach in preservation of environment.

Creating mindful approach amidst residents, water efficiency can be adopted easily in Kolhapur city at residential level:

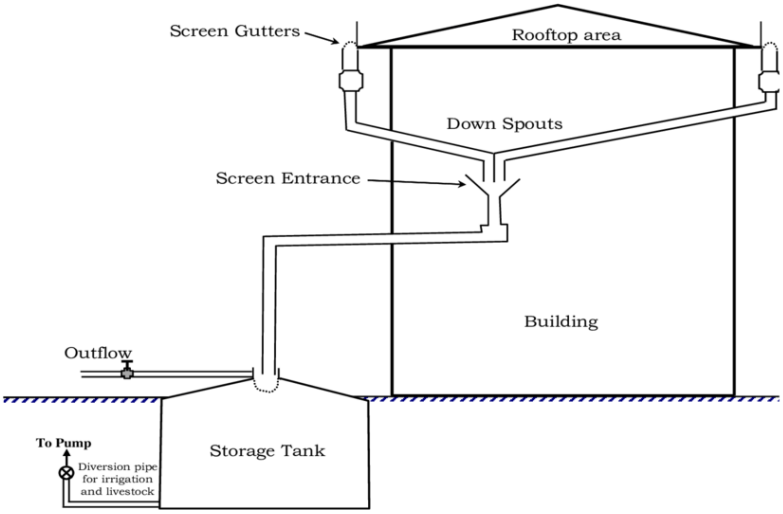
- Management of water

A set of guidelines which highlights the needs of practicing water management in residential buildings can help create awareness amidst residents of the city.

- Rain Water Harvesting

A system that collects rainwater and stores it in tanks, stores it in aquifers, or uses it as drinking water. Harness all rainwater that falls on the premises (except patio/rooftop areas) by providing a way to absorb it on the ground or collect it and use it for non-potable purposes (Ray, 2016).

Figure 1: Rainwater Harvesting

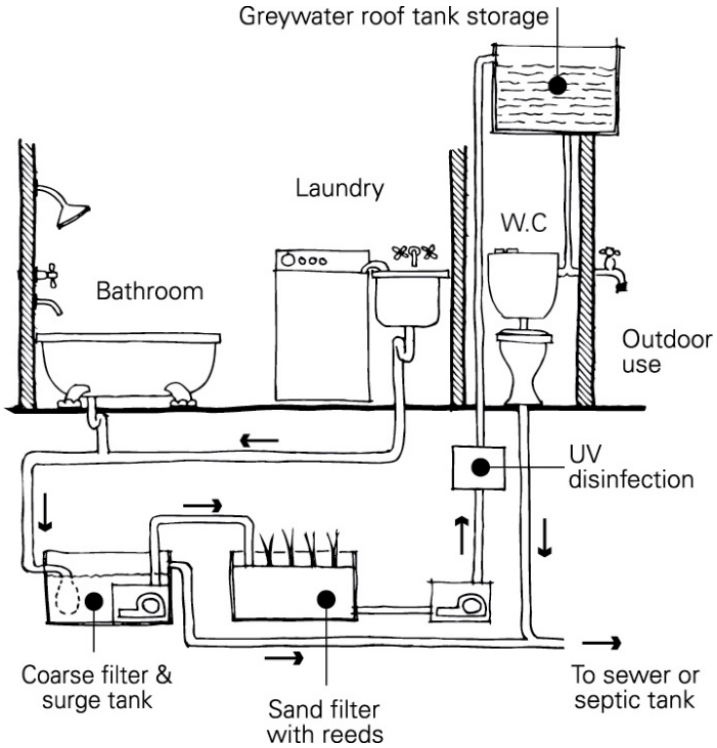


Source: (Ray, 2016)

Recycle and Reuse of Grey Water

Wastewater from non-toilet plumbing systems, including hand basins, washing machines, showers, and bath areas, can be used to flush toilets and other non-potable uses like washing automobiles and watering plants. Grey water treatment systems have a grease and oil trap, a ground filled with straw, and a sand filter and can treat grey water (India, 2021).

Figure 2: Grey Water Treatment Plant



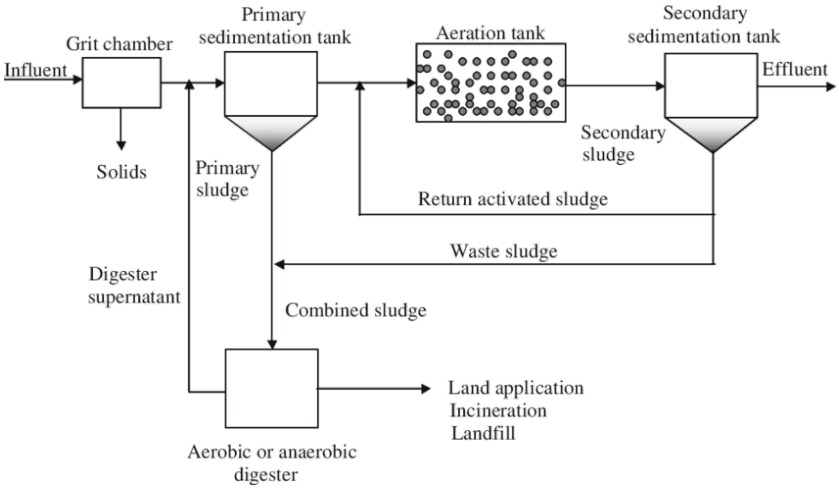
Source: ("Off Grid" Net Zero Water at Birch Case Study House, 2018)

Installation of Sewage Treatment Plant (STP) for Black Water

Black water contains potentially harmful chemical and biological particles, therefore it's best to let it flow into a STP that you can set up at home. STP capacity is frequently determined by the population

and the number of people it can accommodate. Almost 75% to 80% of the water used for domestic purposes is made up of sewage that enters the waste system (S.G.Deolalitkar, 2016).

Figure 3: Sewage Treatment Plant

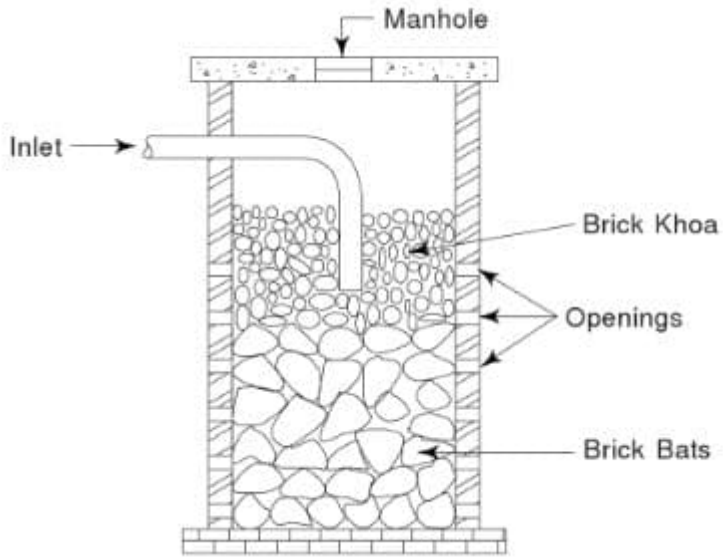


Source: (Sara C Monteiro, 2010)

Soak Pit

A dug-out hole filled with reviewed rocks and stones is referred to as a soak pit. It is connected to a crucial water treatment component of a residential or business structure. It accomplishes the task of allowing septic tank effluent to gradually soak into the foundational earth.

Figure 4: Soak Pit



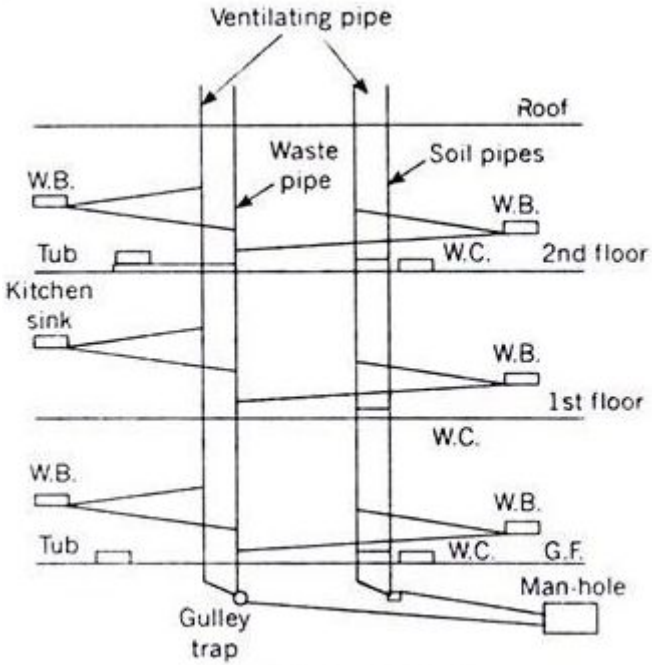
Source: (India, 2021)

Two Pipe System

Water conservation is aided by a split plumbing system that makes it simple to obtain rainwater, grey water, and black water in addition to potable water. (SAIPL, 2019) One pipe plumbing system, waste connections from sinks, showers, washbasins and soil pipe are directly connected to the waste system. Two channels and a two-pipe plumbing system are used. Showers, kitchens, bowls, and other facilities are connected to a separate vertical squander pipe, as are restrooms and urinals. Partitioned vent

channels are provided for soil channels and waste channels. Due to the need for four channels, this system proves to be quite expensive. The waste pipe has to be connected through a captured ravine whereas the soil pipe is connected to drain directly (Daily Civil, 2021).

Figure 5: Two-Pipe Plumbing System



Source: (Daily Civil, 2021)

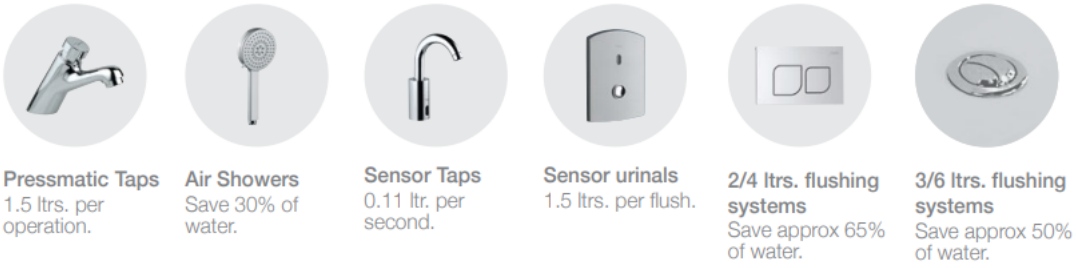
Water Efficient Fixtures

Table 1: Water Efficient Fixtures

Sr.No.	Name	Type of building	Purpose
01	Pressure-Reducing Valves	Residential buildings	To minimize water pressure main water line
02	Flow Restrictors	Residential buildings	To minimize flow rate through the taps in both low and high pressure conditions
03	High-Efficiency Toilets	Residential, commercial buildings	To minimize water from 3.5 gallons per flush to 1.3 gallons per flush
04	Performance Showerheads	Residential, commercial buildings	To minimize water from 2.5 gallons per minute to 1.75 gallons per minute
05	Air showers	Residential buildings	Drops lighter water with a mix of air and water
06	Recirculating Hot-Water Systems	Hotel, commercial buildings, Residential (Smaller units)	Quickly sends hot water from your tank to showers or faucets as needed avoiding waste from the cold water which goes down the drain as one waits for hot water
07	Water-Saving Faucets or Pressmatic Faucets	Residential, commercial buildings	Minimizes water usage from 2.2 liters to 1.5 liters per minute
08	Sensor Faucets	Residential, commercial buildings	Flow of water shuts as soon as the hands move away
09	Dual Flush	Residential, commercial buildings	Enable to use water for flushing either 3/6 liters or 2/4 liters

Source: (Water-Saving Plumbing Fixtures, 2020)

Figure 6: Jaguar Water Efficient Fixtures



Source: Jaguar Consumer Guide

3. Research Methodology

This study's main goal is to underline the importance of domestic water management at single unit residential bungalows in Kolhapur.

3.1. Primary data is gathered by visiting Kolhapur Municipal Corporation (KMC), which has a population surpassing 100 people living in a single building, and collecting water bills from a group of

individuals who live in residential buildings. A survey was done to determine Kolhapur's existing water usage pattern. By collecting data from the Kolhapur Municipal Corporation, manufacturers, dealers, and government resource personnel for essential data collection, the need of effective water management is acknowledged. Methods including taking pictures, talking to experts, and documenting locals' and experts' opinions are used.

Case studies- In order to conduct case studies, we visited nearby single-family homes (bungalow type) and spoke with people who had installed rainwater harvesting system (RWHS), sewage treatment plant (STP), and other domestic water management techniques. As the concept of efficient water management is not very common due to the ignorance of the local population, RWHS and septic tank are installed at the most.

3.2. Secondary data is assembled through online research on several search engines, secondary data on water management, grey and black water, and rainfall harvesting are investigated and obtained. Information is gathered from government, non-government, and national organizations in India. Newspaper stories and the Environmental status report 2015-16 both include information on the state of water management in Kolhapur. The use of different types of water conservation techniques, water management systems at the residential level, the reuse and recycling of grey water, net zero water strategies and support systems, various government programs, and current water-related policies, both international and national, are all examined in literature reviews, research papers, and conference proceedings.

4. Case-study on Existing Water Management Techniques in Kolhapur

4.1. Project Details

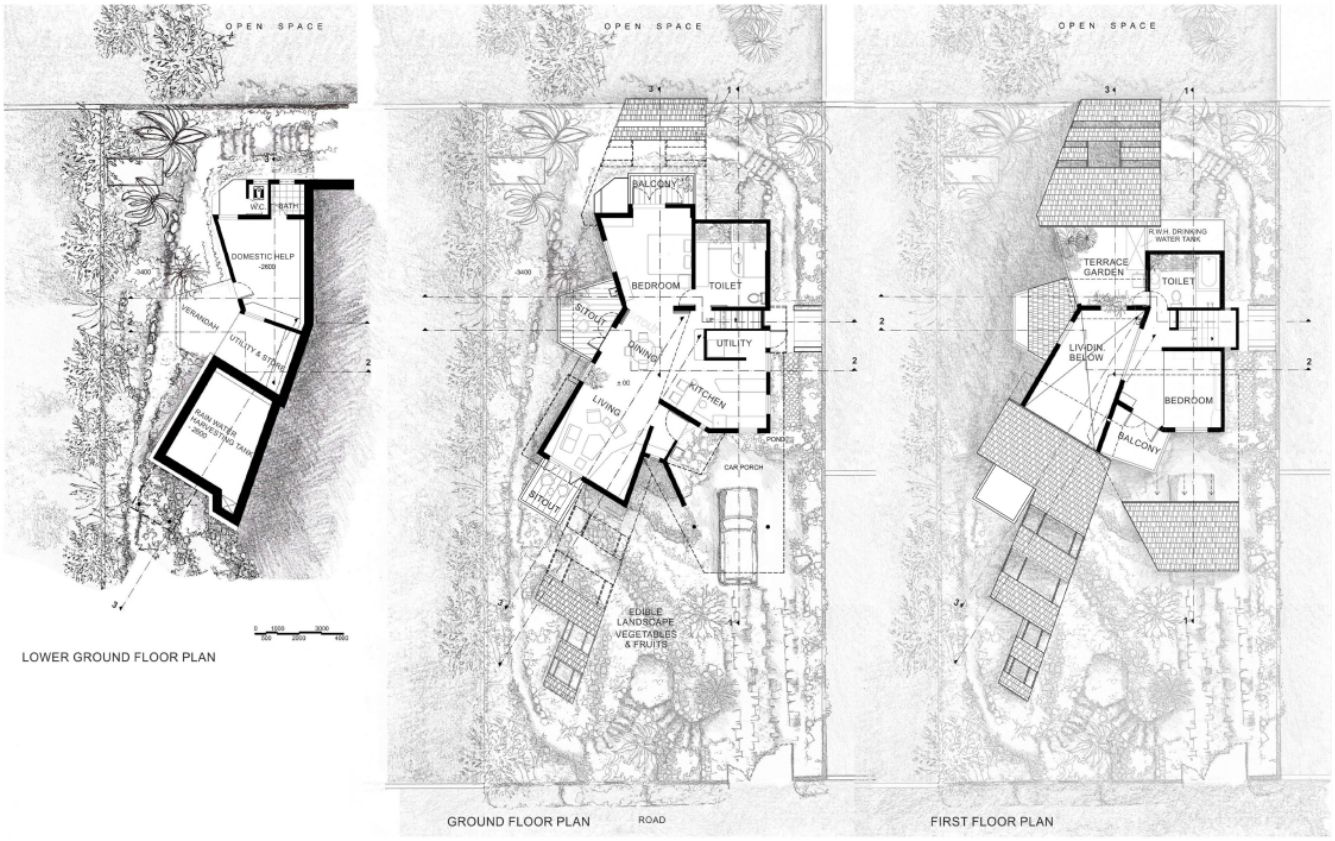
Table 2: Project Details

Sr. No.	Title	Description
1	Name	Laya, Kolhapur
2	Location	Revenue Colony, Kolhapur
3	Building Type	Residential
4	Resident’s Name	Manasi & Shirish Beri
5	Architect	Shirish Beri
6	Area	220 sq. m.
7	Project Cost	25 Lakhs (INR)
8	Project Commencement	2012
9	Project Closure	2014
10	Features	Rainwater harvesting, usage grey water for gardening, septic tank

Source: Ar. Shirish Beri

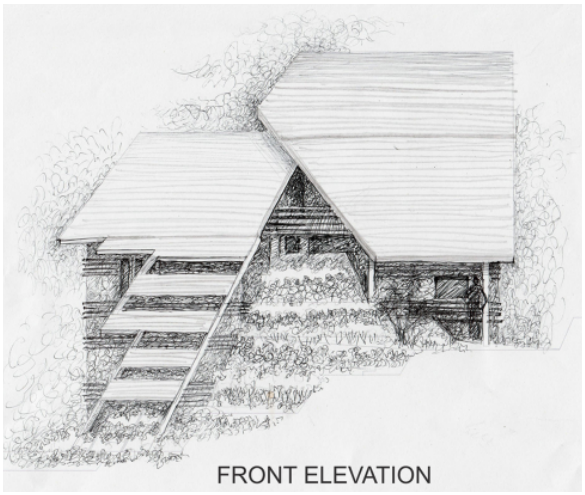
Architectural Drawings and Site Photos

Figure 7: Floor Plans



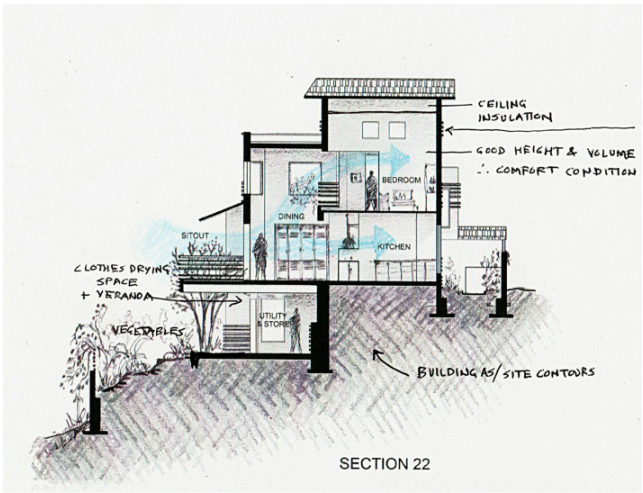
Source: Ar. Shirish Beri

Figure 8: Front Elevation



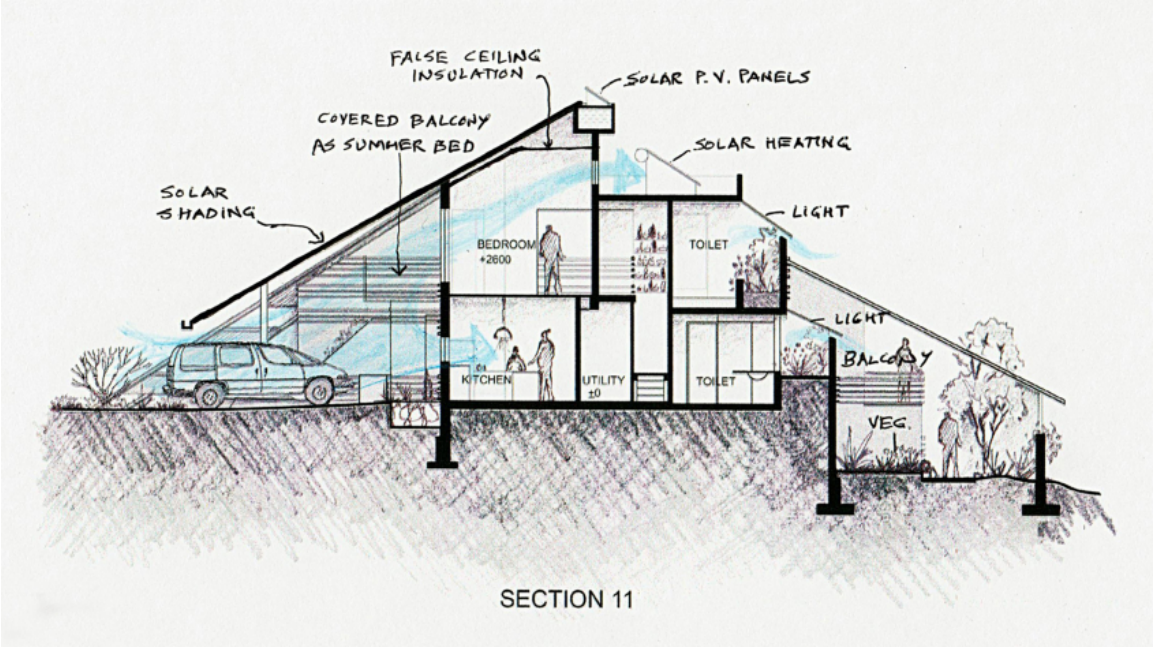
Source: Ar. Shirish Beri

Figure 9: Section 22



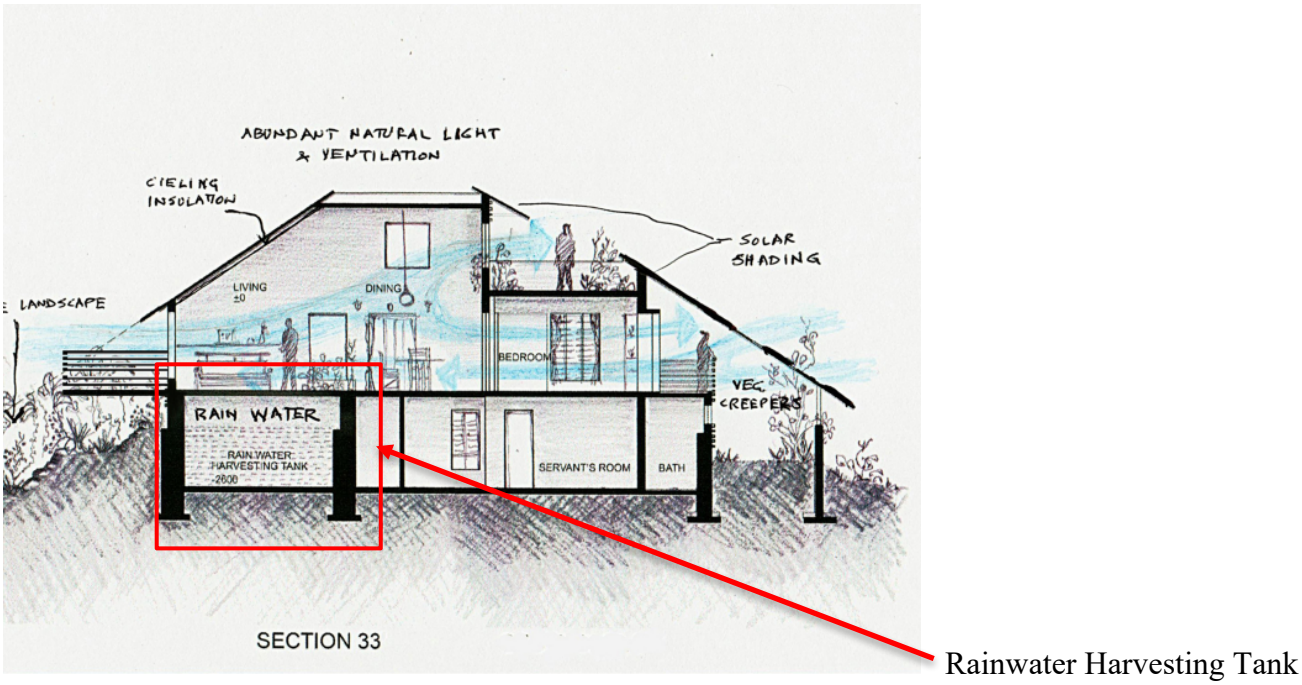
Source: Ar. Shirish Beri

Figure 10: Section 11



Source: Ar. Shirish Beri

Figure 11: Section 33



Source: Ar. Shirish Beri

Figure 12: Image of the Residence

Source: Ar. Shirish Beri

Figure 13: Image of the Entrance

Source: Ar. Shirish Beri

Figure 14: Rainwater Harvesting Tank

Source: Ar. Shirish Beri

Figure 15: Image of the Toilet

Source: Ar. Shirish Beri

4.2. Features

- On-site rainwater harvesting equipment's are installed. This filtered rainwater is used for drinking, and a second faucet is available in the kitchen sink for potable water, which is used for cooking and drinking. As there is reduced water use, this water is almost utilized for six months to a year. Sand filtration is a filtering technology.
- The terrace is washed by the first rain, preventing the usage of water in the 20,000L rainwater storage tank and the 30,000L rainwater harvesting tank. After the terraces have been cleaned, a rainwater gathering plant will begin to function, cleanse the water, and store it for the remainder of the year.
- Instead of having a grey water treatment system, grey water is simply thrown into the garden, where it encourages the growth of plants. 1500L septic tank, which receives both solid waste and black water, is used for these purposes.
- The fixtures and fittings in the bathrooms are of Jaguar.
- Kolhapur Municipal Corporation's water consumption is reduced on purpose; during the wet season, use is practically non-existent.

5. Conclusion

It is possible to infer that rainwater harvesting systems and sewage treatment plants should be put in every residential bungalow because they may lower our fresh water consumption and also keep a check on the working of these systems at the same time. Saving water results in lower water bills and decreased electrical use. Water overflow can also be directed to recharge the ground water table or directly into the soak pit. Water efficient fixtures can be used. Two pipe system can also be adopted. All these steps will save both water and money after it initial cost of installation and eventually make Kolhapur city self-sufficient. Hence, proved the importance and application of efficient water management in single unit residential bungalows at Kolhapur.

6. References

[1] Y. Loomis. (2014).
[2] E. Sharman. (2010).
[3] Q. Hanjra. (2010).
[4] UNDP. (2017).
[5] WHO. (2006). Overview of Grey Water Management Health Considerations. World Health Organization, Regional Office for the Eastern Mediterranean Center for Environment Health Activities, Amman, Jordan.
[6] S.K. Ray (May 2016). Promotion of Improved Cultivation Practices in Agri & Allied Sector for Food and Nutritional Security. Joint Director ICAR Research Complex for NEH Region, Nagaland Centre, Jharnapani.
[7] Government of India. (July 2021). Manual- Grey Water Management. Retrieved from Department of Drinking Water and Sanitation, Ministry of Jal Shakti, Government of India.
[8] "Off Grid", Net Zero Water at Birch Case Study House. (April 2018). Retrieved from Building Innovation Database.
[9] S.G. Deolalitkar. (2016). Plumbing Design & Practice. Sterling Book House.
[10] David M. Whitacre, Sara C. Monteiro, Alistair BA Boxall. (2010). Occurrence and Fate of Human Pharmaceuticals in the Environment.
[11] Shubham Acqualink India Pvt. Ltd. (January 2019). The Importance of Water Management in Residential Complexes.
[12] Daily Civil. (2021). Retrieved from System of Plumbing System.
[13] Water-Saving Plumbing Fixtures. (December 2020).