RAIN WATER HARVESTING

Submitted in partial fulfillment of the Degree of

Bachelor of Technology

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Under supervision of

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Certificate

This is to certify that project report entitled "**RAINWATER HARVESTING** ", submitted by **AMAN GUPTA ,VISHESH SHARMA AND MRIDUL SEHRA** in partial fulfillment for the award of degree of Bachelor of Technology in Civil Engineering to Jaypee University of Information Technology, Waknaghat, Solan has been carried out under my supervision.

This work has not been submitted partially or fully to any other University or Institute for the award of this or any other degree or diploma.

Date: **Supervisor's Name**

Designation

Abstract

The Collection and utilization of urban rainwater is currently a substantial measure of ecological construction in the city which covers a variety of technologies used and reflected in the multi-dimensional overlap with the urban space. By analyzing the current trends in related technology in the world, the paper probes the organic integration of rainwater collected system with urban spatial structure and elements in a view of overall optimization. People usually make complaints about the lack of water. During the monsoons lots of water goes waste into the gutters. And this is when Rain water Harvesting proves to be the most effective way to conserve water. We can collect the rain water into the tanks and prevent it from flowing into drains and being wasted. It is practiced on the large scale in the metropolitan cities. Rain water harvesting comprises of storage of water and water recharging through the technical process In this project a proper rain water harvesting system will be designed and its feasibility will be checked.

Acknowledgement

We would like to take this opportunity to express our heart filled thanks to all the people who have directly or indirectly given a hand in making this project possible. We would especially like to thank the faculty and the staff members of the Civil Engineering Department, JUIT, and Waknaghat who have always been supportive and made this project possible. We would like to thank our project supervisor **Dr. Ashish Kumar** for clearing all our queries regarding the design part of the project and giving us the opportunity to do this project on such a beneficial topic for our career and guiding us throughout the whole project. Without his presence this project would not have been possible. He had been very helpful and supportive..

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Table of Contents

List of tables

List of Figures

List of Graphs

CHAPTER 1

INTRODUCTION

After thousands of years of human development in which water has been a plentiful resource in most areas, amounting virtually to a free good, the situation is now abruptly changing to the point where, particularly in the more arid regions of the world water scarcity has become the single biggest threat to food security, human health and natural ecosystems.

1.2 Rainwater harvesting

Rainwater Harvesting is defined as the process of collecting and storing rain for later productive use. Rainwater harvesting is a mini-scale water resources project that collects, stores rainwater by structural measures and regulates and makes use of it for domestic and production use. The term water harvesting refers to collection and storage of natural precipitation and also other activities aimed at harvesting surface and groundwater, prevention of losses through evaporation and seepage and all other hydrological studies , aimed at conservation and efficient utilization of the limited water endowment of a physiographic unit, such as a watershed. The project seeks to address the issue of rainwater harvesting for houses, apartments, industries and institutions especially in an urban context. It does not specifically exclude peri-urban and semi-rural area as land use restrictions in many cities push industries to peripheries and fringes. The main focus is however industries. Water demand all over the country and internationally is rising rapidly. Though agriculture continues to be the single largest sect oral consumer of water worldwide, industrial demand for water is also escalating sometimes at a much faster pace than any other demand. Traditional and Centralized piped water supply system s are finding it difficult to cope with meeting such exploding demand. Ground water is also depleting especially in Metropolitan Cities.

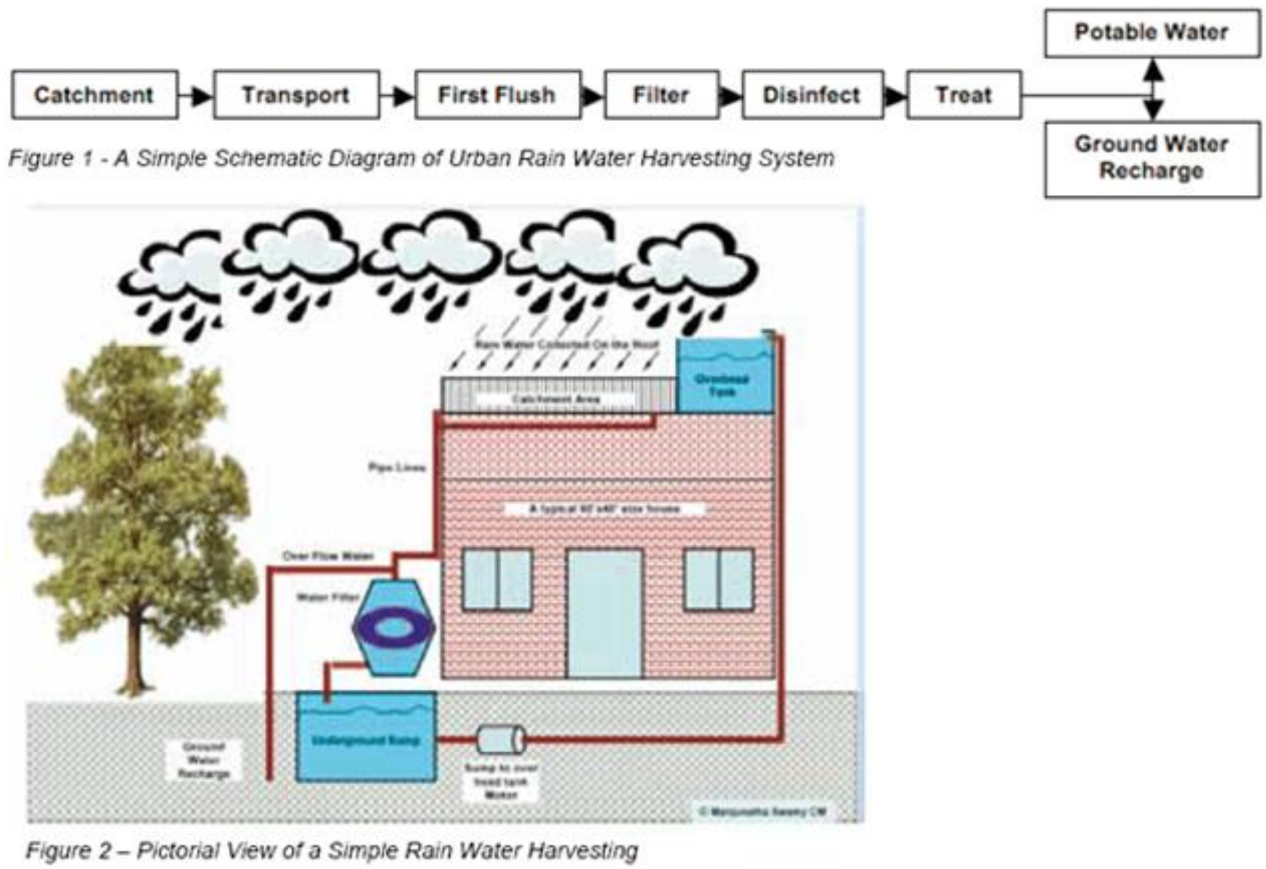


Fig 1.1

1.3 Need Of Rain Water Harvesting in Urban Areas:

Urban areas are confronted with many issues pertaining to water-

- Lack of full water from traditional sources and therefore rainwater as a supplementary source.
- Urban flooding therefore rainwater harvesting as a flood mitigation measure.
- Depletion of groundwater aquifers and therefore rainwater harvesting as a method of artificial recharge.
- Disappearance of lakes and natural hydrological courses therefore rainwater harvesting as a method of restoring these water bodies.
- Bore wells are either silting up, getting short of water or are drawing polluted water.
- Increasing Population is another major factor.

1.4 Project Objective:

The purpose of this project is to assess a sustainable water harvesting solution for communities of the study area of Delhi and hilly region. It also seeks to give the overview about technologies of water harvesting in India. The main objective of the project is to find out the appropriate water harvesting system for the communities who do not have the enough access to safe water. Therefore the basic objectives are:

- Identify water related problem in the study area.
- Identify and analyze the water harvesting methods in India.
- Develop a solution for water harvesting system for the community in the project area.
- Visualizing the efficiency of the project.

1.5 System of rainwater harvesting

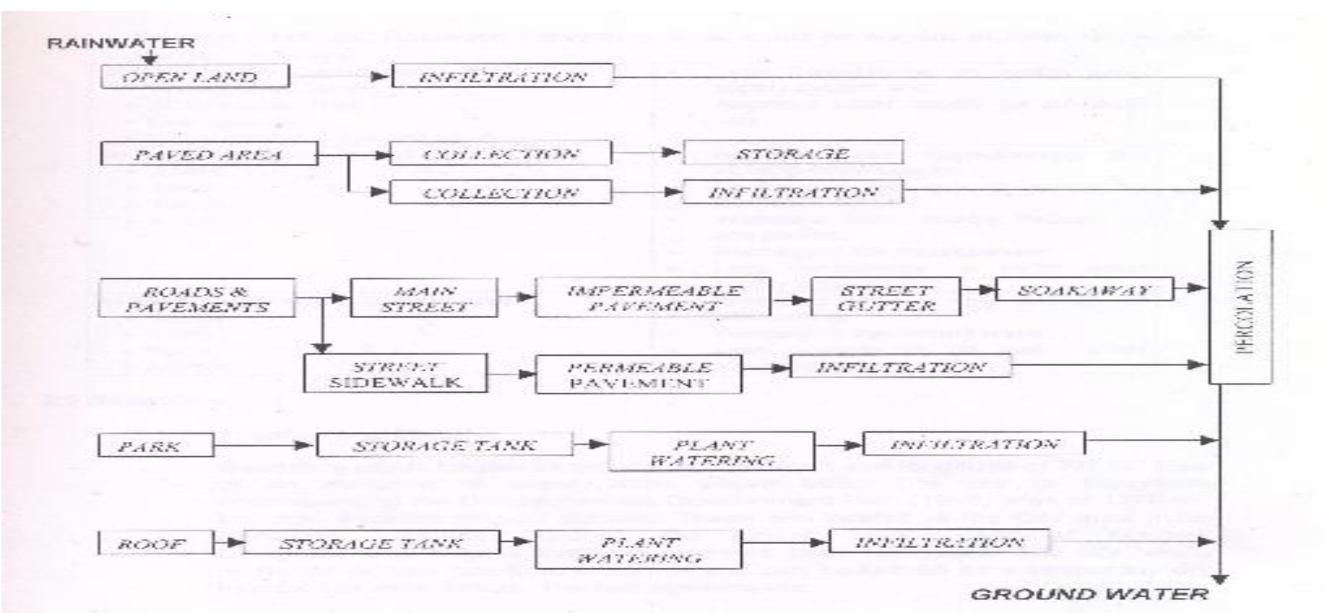


Fig 1.2

1.6 Assumptions

The project aims to find appropriate, affordable and environment friendly approaches for the water harvesting system. Considering the above criterion the basic assumptions has been predefined. The assumptions are:

- No environmental or other contamination other than those from the catchment area will be present in the harvested water.
- The rainwater harvesting method is socially accepted in the study area.
- Water consumption is assumed to be above 150 MLD (excluding gardening and landscaping).
- Rainfall in the area supports the RWHS.

CHATPER 2

LITERATURE REVIEW

2.1 Literature Review

It is affirmed that Water forms the lifeline of a society. Safe water is essential for the environment, disease reduction as well as for sustainable development. Availability of drinking water and provision of sanitation facilities are the basic minimum requirements for healthy living. Water supply and sanitation, being the two most important urban and rural services, have wide ranging impact on human health, quality of life, environment and productivity. Despite the technological advancements, the global scenario still remains grim, as all the inhabitants of the world do not have access to safe water and adequate sanitation..

2.2 Types of Rain Water Harvesting System

There are different types of RWHS in all around the world. The technology and design varies according to physiographic, climate, culture etc. the system is mainly found in remote part of the developing countries where access to safe water is a problem. The RWHS comprises of three basic elements. They area;

1. The collection system

2. The conveyance system

3. The storage system.

All the three system varies according to the rainfall, catchment area and reservoir types.

2.3 Characteristics of water demand:

Urban areas are typically characterized by concentrated demand because of high population densities and the sheer number of people. Especially in the developing world the growing population adds to a growing demand typically unmet. In addition the major problem is of skewed distribution with the relatively well-off accessing more water and the economically disadvantaged having to do with very little.

Typical urban demand for water is characterized at least in the Indian context as :

- ***Domestic*** – for household use and consumption
- ***Non-domestic*** – for commercial and service sector demand as well as that for schools parks, hospitals etc.
- ***Industrial*** – for minor and major industries and factories
- ***Recreational use*** – for boating, fishing, water sports
- ***Ecological use*** – As a place for preserving and fostering bio-diversity.
- ***Environmental use*** – To moderate the micro climate and to absorb storm run-off as a detention basin.
- ***Agricultural use*** – For parks, gardens and for urban agriculture.

In the fast growing cities Industrial demand shows spectacular growth and is the fastest rising demand in the Indian context.

2.4 Sources of urban water supply:

Much of the supply comes from rivers or lakes and the constant quest of engineers is to seek these 'perennial' sources. Then comes the putting up of reservoirs for storage, treatment plants, pumping stations, supply lines, storage reservoirs and distribution pipes. Underground aquifers too are another source from open wells or deep bore wells water is pumped up and distributed. As local sources dry out, become polluted or are simply insufficient the city marches farther and farther for its water

2.4 Criticism of rainwater harvesting:

Criticism is best articulated as the lack of dependency and unreliability of rain and rainwater, its supplemental role as opposed to a full replacement role, problems of quality especially chemical and microbiological contamination, the hazards of vector breeding, the uneconomical aspects of rainwater harvesting bad cost benefit ratios.

2.6 Limitations:

Rainwater Harvesting system is site specific and depends on local rainfall hence it is difficult to give a generalized idea and make it successful. Household base RWHS is used to harvest drinking and cooking water. But other daily activates are not possible by the harvesting system. Big and community base RWHS can provide chance to use water for other purpose like bathing, washing, irrigation but the maintenance of this types of RWHS is difficult.

Incorrect prediction of rainfall can make the system unusable. The Action Research project executed by NGO has shown that a rainwater harvesting system was favored by the consumers over dug well. Further In public supply situations it is often not easy to put adequate management systems in place and so RWHS fall in disrepair due to conflict, or they become the user right of some specific households.

CHAPTER 3

Methodology

3.1 Methodology

The purpose of this project is to evaluate opportunities and options of water harvesting systems which is safe, affordable and socially acceptable. Therefore qualitative and quantitative data are used for this project. The methodology of this project is confined to field observation, interviews, data presentation and analysis. For the better understanding of the site situation both primary and secondary data sources are used. In order to assess the appropriate water harvesting system, various formal and informal approaches are adopted in the field survey and data analysis. The location variation is analyzed by considering the physiographic, climate, social structure and availability of materials for water harvesting systems. Community's idea and culture related to water harvesting system is analyzed carefully

3.2 Traditional methods of Rainwater Harvesting

3.2.1 General

Traditionally, rainwater harvesting which is still prevalent in rural areas, was done in surface storage bodies like lakes, ponds, irrigation tanks, temple tanks etc. In urban areas, due to shrinking of open spaces, rainwater could be harvested as ground water only. Hence harvesting in such places depends very much on the nature of the soil viz, clayey, sandy etc. Some of the traditional rainwater harvesting methods is described in the following sections:

3.2.2 Kund of thar method

In the sandier tracts, the villagers of the Thar Desert had evolved an ingenious system of rainwater harvesting known as Kunds or Kundis "kund" the local name given to a covered underground tank, was developed primarily for tackling drinking water problems. Usually constructed with local materials or cement. Kunds were more prevalent in the western and regions of Rajasthan, and in areas where the limited groundwater available was moderate to highly saline soil. Under such conditions, kunds provided convenient, clean and sweet water for drinking.

Fig 3.1 Kunds of thar desert

3.2.3 Kul Irrigation Method

This method is suitable when the soil is dry and lacks organic matter. Despite many handicaps, the Spiti valley has been made habitable and productive by human ingenuity. Spiti's unique contribution to farming is Kul irrigation, which utilizes Kuls(diversions channels) to carry water from glaciers to village. The Kuls often span long distance, running down precipitous mountain slopes and across crags and crevices. Some Kuls are 10 km long, and have existed for centuries.

The crucial portion of a Kul is its head at the glacier, which is to be trapped. The head must be kept free of debris, and so the Kul is lined with stones to prevent clogging and seepage. In the village, the Kul leads to a circular tank from which the flow of water can be regulated.

Water from the Kul is collected through the night and released into the exit channel in the morning. By evening, the tank is practically empty, and the exit is closed. This cycle is repeated daily.

Fig 3.2

3.2.4 Bamboo Rainwater Harvesting

In Meghalaya, an ingenious system of tapping of stream and spring water by using bamboo pipes to irrigate plantations is widely prevalent. It is so perfected that about 18-20 liters of water entering the bamboo pipe system per minute gets transported over several hundred metres and finally gets reduced to 20-80 drops per minute at the site of the plant.

Bamboo pipes are used to divert perennial springs on the hilltops to the lower reaches by gravity. The channel sections, made of bamboo, divert and convey water to the plot site where it is distributed without leakage into branches, again made and laid out with different forms of bamboo pipes. Manipulating the intake pipe positions also controls the flow of water into the lateral pipes. Reduced channel sections and diversion units are used at the last stage of water application. The last channel section enables the water to be dropped near the roots of the plant.

Fig 3.3

3.2.5 Temple Tanks of India

It is also a traditional method of rainwater harvesting, which was very prevalent in ancient India. A large number of temples are built in India, and most of them have there separate tanks to cater to the needs of the temple and the locals. The tanks during rainy seasons gets filled with water and then used for various purposes by the locals.

Other Common Methods

The modern method of rainwater harvesting is discussed in this chapter. The rainwater harvesting methods for individual houses and grouped houses are classified into the following categories explained as under.

1. Bore Well With Settlement Tank
2. Open well method with filter bed sump
3. Percolation pit with bore method

1. **Bore Well With Settlement Tank**

Rainwater collected from rooftop of the building is diverted through drainpipes to settlement or filtration tank. After settlement, filtered water is diverted to bore wells to recharge deep aquifers. Abandoned bore wells can also be used for recharge.

Some of the features of system include

- Roof top water may also be diverted to a bore well.
- Filter tank of required size has been provided.
- Overflow water may be diverted to percolation pit nearby.
- Defunct bore wells may also be used

2. Open well method with filter bed sump

Rainwater from terrace is diverted to the existing open well using PVC pipes through a filter chamber. The filter is filled with broken bricks in the bottom and sand on the top. The chamber is covered with RCC slab.

3. Percolation Pit with Bore Method:

In this method a borehole is drilled at the bottom of the percolation pit. The depth of these bore holes is approximately 10-15ft. This method of rainwater is harvesting is only suitable for clayey area. Some of the features of the system include

- Above structures are meant for area with small catchments like individual houses.
- RCC slab cover is optional.
- Top portion may be filled with sand.

3.3 Design Steps:

1. Determine catchment area and stratify to

-rooftops;

-paved areas;

-unpaved areas

2. Segregate to harvestable and non-harvestable areas.

3. Collect rainfall data from nearest rain measuring station, preferably monthly data, for 30 years.

4. Calculate rainfall endowment and rainfall harvestable for two catchments i.e. rooftops, paved areas.

5. Design storage and recharge systems based on maximum or optimum intensity of rainfall.

6. Provide filters, silt traps, grease traps and appropriate locations.

7. Device a catchment management strategy to prevent and avoid pollution (Generally for industrial RWHS).

8. Identify water consumption for various demands and work toward reducing demand.

9. If you are recharging ground water how much are you improving quantity of ground water.

10. Always be sure of the quality of groundwater you send into the ground.

11. Look for defunct storage systems. Sometimes empty sumps and unused septic tanks or construction sumps may be available for storage.

12. Work out a cost benefit analysis based on present and future costs of water.

13. Examine whether separate storage and lines for potable water and non-potable water can be made available or not.

14. Remember rainwater harvesting minimizes storm runoff and soil erosion in m any sites.

Rainwater harvesting is practiced in over 65 countries and is the future of sustainable water management strategies.

3.3 Components of Rain Water Harvesting

- Catchment
- Gutters and Down take pipes
- Filters
- First flush Filter
- Storage tanks
- Delivery systems

3.3.1 Catchment types:

- **Roof catchments**: The rooftop is usually the most common catchment surface and can be flat or sloping. Smooth, hard and dense roofs are preferred since they are easier to clean and are less likely to be damaged and release materials/fibers into the water. The catchment surface should slope slightly towards the down take pipes so that water does not get stagnate on the roof.

- **Ground level catchments**: If the storage tank is below the ground level, paved flooring surfaces and open grounds can also serve as catchments.

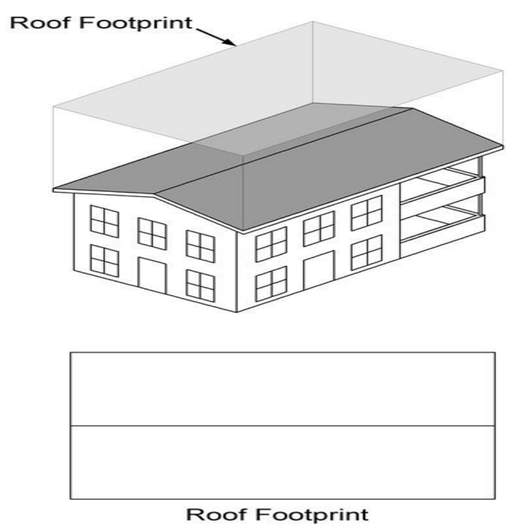


Fig. 3.4

3.3.2 GUTTERS:

Gutters are pipes around the edge of the roof (usually sloped roofs) that collect and transport rainwater from the roof. Down take pipes are cylindrical pipes that transport the water down, directly from the roof or from the gutters, until the storage tank.

Gutters implemented for sloped roofs can be of different shapes.

- The semicircular and trapezoidal shaped gutters offer least resistance and result in optimum flow. Their wider mouth reduces wastage of water by splashing.
- Semicircular gutters are usually preferred since other shapes are not easily available and this one can be easily created by slicing a PVC cylindrical pipe in half.
- Rectangular, trapezoidal and V shape gutters are usually made from Zinc sheets.

Common material for down take pipes are ultra-violet treated Poly Vinyl Chloride (PVC), Galvanized Iron (GI), Cast Iron and asbestos cement.

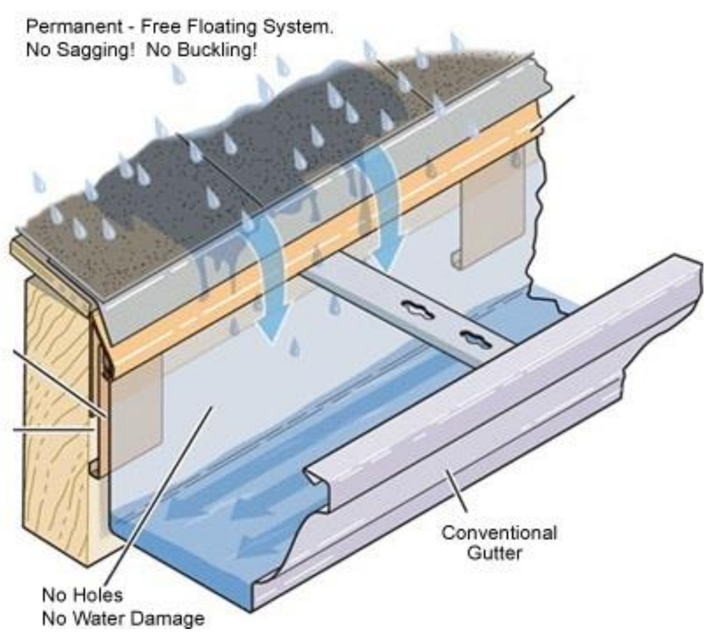


Fig.3.5

DOWN PIPES:

Down take pipes will be present in most buildings, leading rainwater to the ground. Older constructions would have asbestos cement pipes but more recent ones would have PVC, and in a few cases GI down take pipes. PVC pipes are preferred since they are

- Lightweight,
- cost effective,
- do not rust,

- are easy to procure, install and repair and
- allow for increased flow rates because they are smoother than their metal counterparts

Fig.3.6

Sizing of rainwater down take pipes:

The diameter of the down take pipes varies depending on the roof area to be drained and the peak intensity of rainfall. A bell mouth inlet at the roof surface is found to give a better drainage effect. Gutters should preferably be smaller or the same size as the down take pipes, depending on the number of gutters that lead into one down take pipe.

3.3.3 FILTERS:

It is preferable to filter the rainwater before storing it. If leaves and other organic material enter the storage tank, they decompose and support bacterial growth in the tank. Dirt and other debris, if not filtered out, can cause blocks in the plumbing system when the stored rainwater is used.

- **Primary filters / leaf guards:**

The first level of filtration could be a grating at the outlet of the catchment or the inlet of the gutters or down take pipes to prevent large coarse debris like leaves from entering the rainwater transportation and storage network. For open gutters, leaf guards which are usually?” mesh screens in wire frames may be installed along the length of the gutter.

The rooftop must be regularly cleaned for the leaf screens to be effective, else the piled up leaves will clog the screen and prevent rainwater from entering the gutters or down take pipes. This can even result in leakage of water from the roof. If wire meshes or gratings are not used at the outlet of the catchment, the filtration system installed should be able to segregate such debris from the collected rainwater.

Fig.3.7

- **Secondary filters:**

This filter can be made by PVC pipe of 1 to 1.20 m length; Diameter of pipe depends on the area of roof. Six inches dia. pipe is enough for a 1500 Sq. Ft. roof and 8 inches dia. pipe should be used for roofs more than 1500 Sq. Ft. Pipe is divided into three compartments by wire mesh. Each component should be filled with gravel and sand alternatively as shown in the figure. A layer of charcoal could also be inserted between two layers. Both ends of filter should have reduced of required size to connect inlet and outlet. This filter could be placed horizontally or vertically in the system.

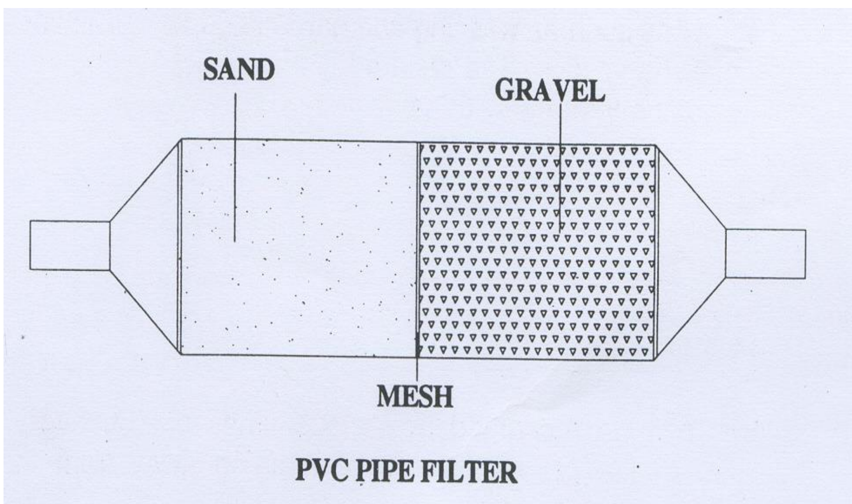


Fig.3.8

Table 1.1

Sand Filters	Mesh Filters
Can be assembled with locally available materials and not dependent on product availability in a particular region	Off-the-shelf products which are easy to install but availability depends on marketing initiative of manufacturer
Higher efficiency than some mesh filters, provided the filter does not overflow	Slightly lower efficiency than sand filters since some water is used to wash away dirt and debris
Requires regular maintenance	Some mesh filters require regular maintenance but others are relatively low-maintenance products
Requires floor space	Wall – mounted
Overflow may occur during heavy rain or if the filter is clogged	Overflow may occur if the filter is clogged
Overflow system can be a problem for below ground storage tanks	Overflow systems can be provided for below ground storage tanks
Costs can increase if masonry support structures are required and if multiple filters are required for larger rooftop areas	Some models are cost effective especially for larger rooftop areas

3.3.4 Storage tank:

Storage tanks are the most expensive part of a rainwater harvesting systems, so due consideration must be given to its design and construction. The size of the storage tank depends on the amount of rainfall that can be harvested, the demand, aesthetics and budget. The availability of labor and materials / off-the-shelf products, cost, time, and other external factors are important in deciding the tank material and type. They can be:

- At or just below a roof slab level
- On the ground
- Completely or partially below the ground (sump)

Storage tanks are commonly constructed with the following materials:

- Brickwork with cement plastering
- Reinforced Cement Concrete (RCC)
- Ferro cement
- Plastic or polypropylene

The cost of construction of storage tanks can vary from Rs3.50 per litre of storage to Rs 5.00 per litre of storage depending on the material and the size of the tank.

Capacity of the storage tank

The sizing of storage tanks depends on the rainwater yield and demand but in many cases is governed by budget and space limitations. This is more common in areas which have heavy rainfall in some months and short dry spells. In cases where it is not possible to install the recommended size of storage tank, it is advised to collect as much as possible for reuse and recharge the rest.

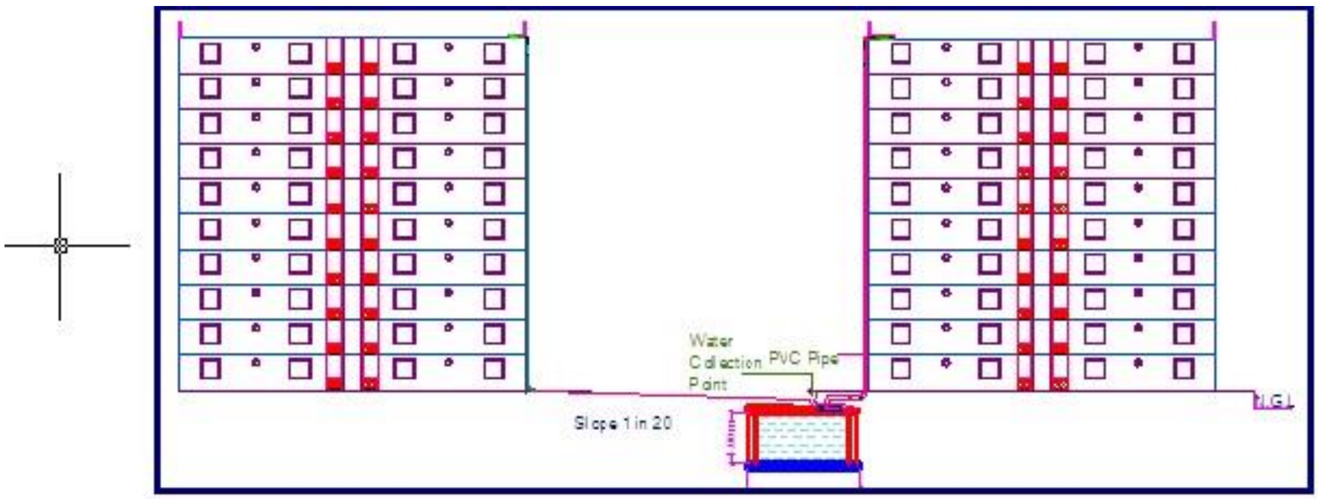
CHAPTER-4

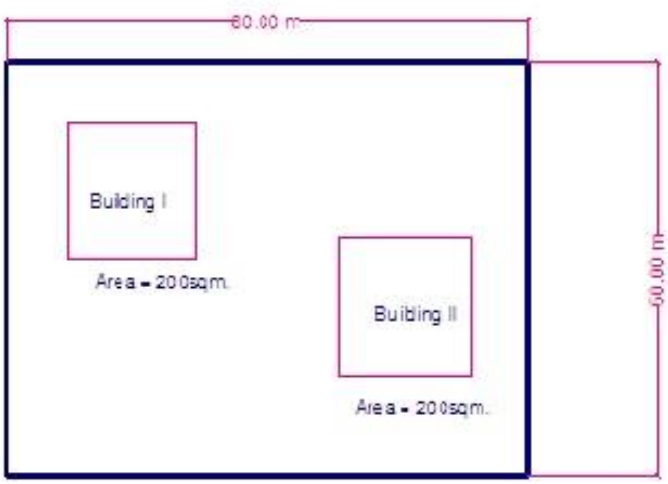
Assessment

Case Study 1

Mahaluxmi Complex, New Delhi

Project Site





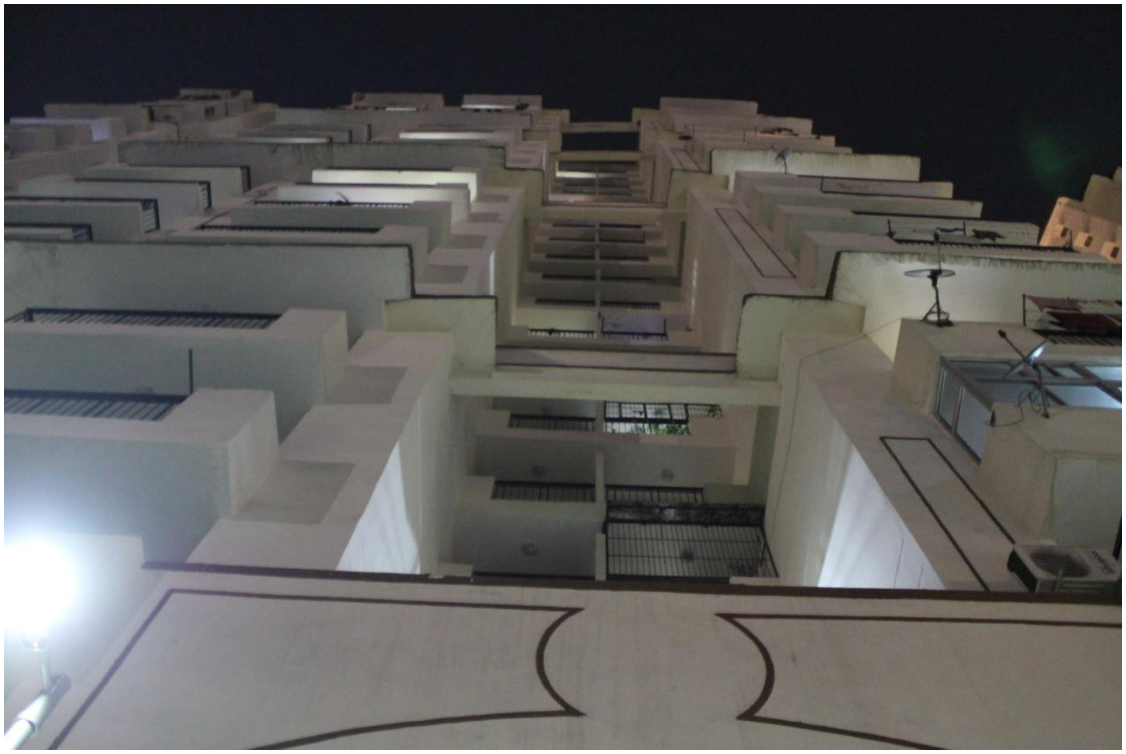


Fig.4.1

4.1.1Water Supply:

Area of roof i.e. catchment area = 20*10 = 200m^2

Paved Area= 400m^2

Avg. rainfall received in Delhi as per the data = 700mm annually.

Total volume of rainfall received in a year = (200+400)*700= 420.00m^3 = 4,20,000 L

As per the norms, we assume that

- 0.80 is the coefficient of roof surface. &
- 0.85 is the coefficient for evaporation.

Total amount of water that can be harvested in a year =.80X.85X420000= 2,85,600L.

Fig.4.2

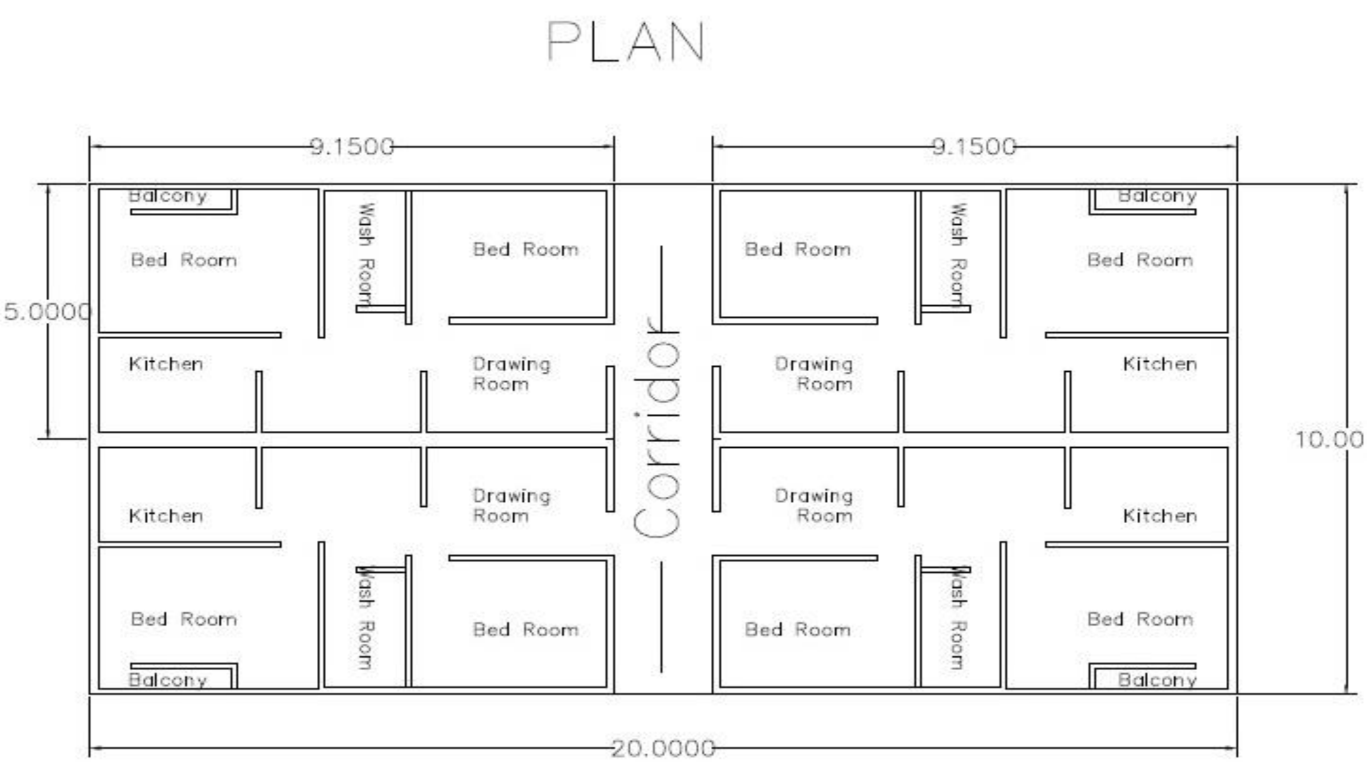

PLAN
9.1500
9.1500
5.0000
10.00
20.0000
Balcony
Bed Room
Wash Room
Kitchen
Drawing Room
Corridor

Fig 4.3

4.1.2 Water Requirement:

- Domestic water consumption(as per IS code) = 150Lpcd (excluding gardening and landscaping)

- Total water requirement for 1 flat(no. of persons per house =4) =4*150 = 600Lpcd

Total no. of flats on 1 floor = 4flats.

- Therefore, total requirement on 1 floor = 4*600 = 2400Lpcd.

Hence, total requirement of water for 10 floors = 2400*10 = 24000Lpd.

Total water requirement of 10 floors in a year = 24000*365=8760000L.

Additional water requirement for landscaping and washing the cars:

=500L/day = 500*365 = 182500L.

Therefore, total water requirement of the complex = 8760000+182500=8942500L

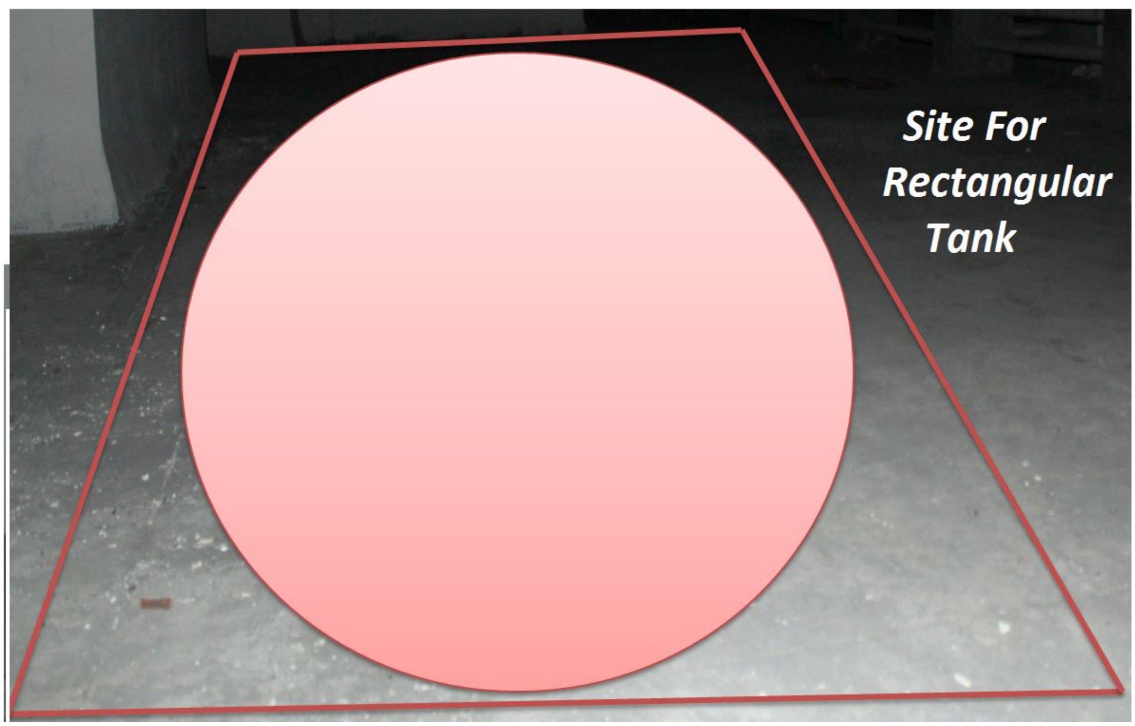


Fig.4.4

Size of tank As per British standards

Annual Demand = 8942500L

Annual Supply = 285600L

The Capacity of storage tank is = 5% of Annual Demand or 5% of Annual supply

= 0.05*8942500 or 0.05*285600

= 44.7125cu.m or 1.428cu.m

Taking the minimum value, Size of Tank is 1.5cu.m

Dimension of tank= 2mX1.5mX0.5m

Since we are not going to meet the all the water requirement of residents. So, we will provide the water harvested for some specific purpose such as Sanitation and Washing.

So, the water requirement of residents for sanitation and washing purpose is= 30+10=40LPCD

Total Water requirement for one flat (assuming 4 persons in a flat)= 40X4=160L

Total requirement of building (4 flats in 1 floor, 10 floors)= 6400L

Annual Demand=6400X365=2336000L

So, Size of tank As per British standards

Annual Demand =2336000L

Annual Supply = 285600L

The Capacity of storage tank is = 5% of Annual Demand or 5% of Annual supply

= 0.05*2336000 or 0.05*285600

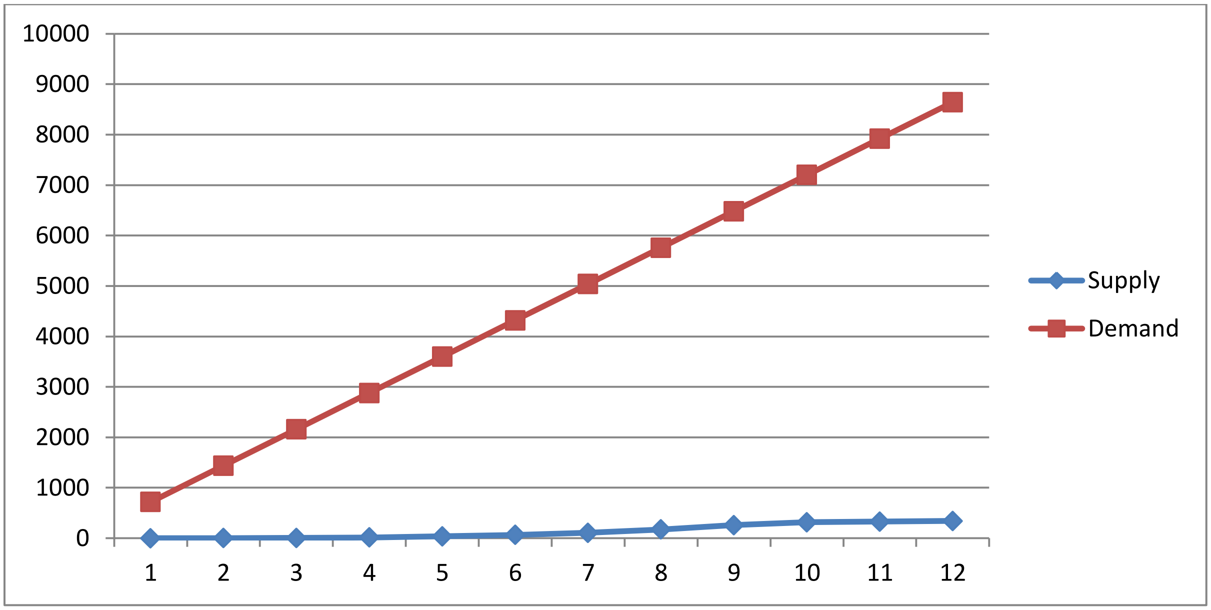
= 11.68cu.m or 1.428cu.m

Taking the minimum value, Size of Tank is 1.5cu.m

Dimension of tank= 2mX1.5mX0.5m

4.1.3 Mass Inflow curve:

- **For 150lpcd**

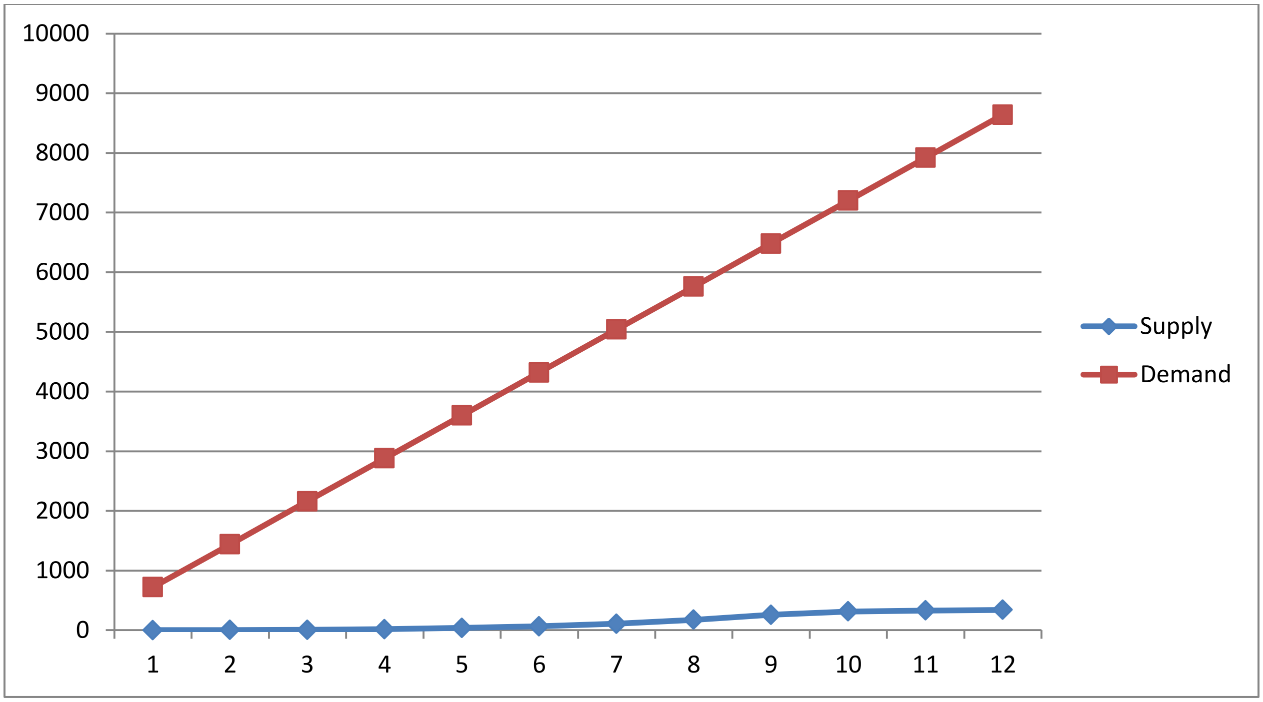


Graph.4.1

UNITS: Along y-axis = m^3 ; x-axis= Years

Water to be supplied from Municipal water supply= 8942500L-2,85,600L = 8656900L

For 40 lpcd



Graph 4.2

4.1.4 For Maximum Rainfall Data Calculation:

- Average maximum Rainfall (July,aug,sep,oct)= 504.34mm
- Area of catchment= 200m^2
- Paved Area = 400m^2
- Volume of water received in these 4 months = (200+400)*504.34

= 3, 02,604 L

As per the norms, we assume that

- 0.80 is the coefficient of roof surface. &
- 0.85 is the coefficient for evaporation

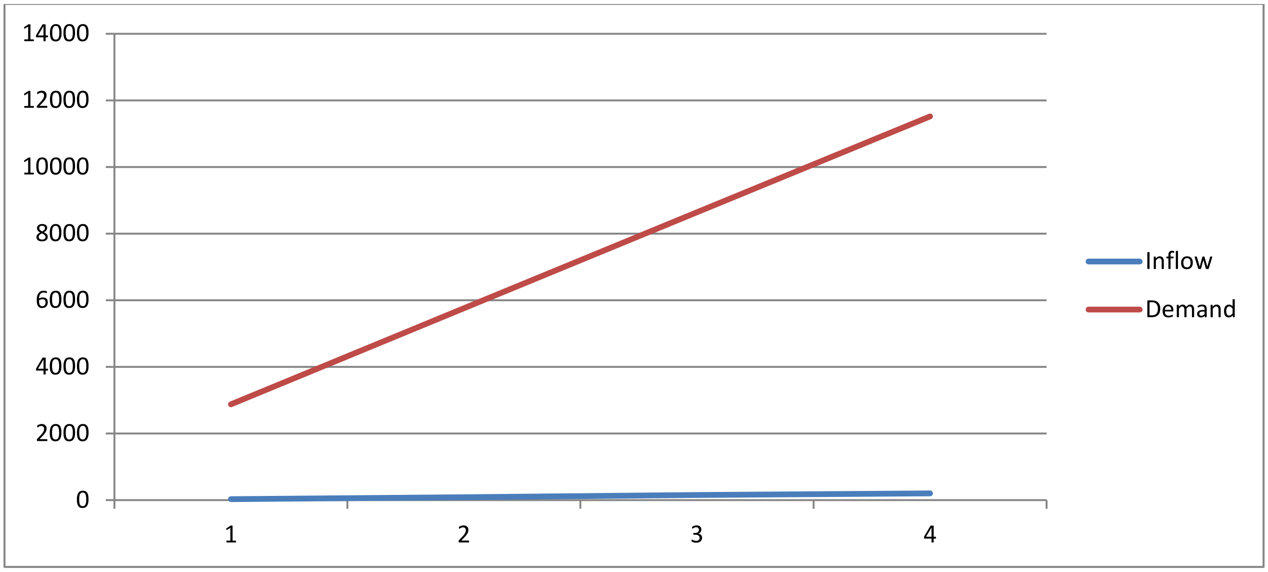
- Volume of water harvested in these 4 months = 302604*0.85*0.80

= 2,05,770L

Water requirement:

- For 4 months(july, aug, sept, oct) = 24000Lpd*120days = 28,80,000 L

Mass Inflow Curve:



Graph 4.3

Units : Along y-axis = m^3; Along x-axis= months

Water to be supplied from Municipal water supply= 2880000-205770=2674230L

4.1.5 Cost Estimation

1 Cost of construction of tank

S.No	Description	Length(m)	Breadth(m)	Height(m)	Quantity(cu.m)
1	Excavation of				
	a) Foundation of tank	7.92	0.8	0.6	3.8016
	b) Tank Wall	2.46	1.96	0.5	2.4108
				Total	6.2124
2	PCC in foundation	7.92	0.8	0.1	0.6336
3	Brickwork				
	a) Step 1	7.92	0.6	0.2	0.9504
	b) Step 2	7.92	0.5	0.1	0.396
	c) Step 3	7.92	0.4	0.2	0.6336
	d) Wall above footing	7.92	0.23	0.5	0.9108
				Total	2.8908
4	Cement Plaster (12mm)in				sq.m
	a)Inside Plaster				
	i) Long wall (2 nos)	2X2	0.5		2
	ii) Short wall (2 nos)	2X1.5	0.5		1.5
	b) Outer Plaster				
	i) Long Wall (2 nos)	2X2.46	0.5		2.46
	ii) Short Wall (2 nos)	2X1.96	0.5		1.96
				Total	7.92

Table 4.1

Abstract of estimated cost

Item No.	Particular of items of work	Quantity	Unit	Rate	Amount
1	Excavation in foundation & Tank	6.2124	cu.m	100	621.24
2	Brickwork	2.89	cu.m	6500	18785
3	PCC	0.6336	cu.m	3600	2280.96
4	Cement Plaster	7.92	sq.m	135	1069.2
				Total	Rs.22756.4

Table 4.2

2. **Cost of pipes-**

Length of pipe required= 2X90=180m

Cost of 6m of pipe = Rs.529.6

Cost of 180m of pipe= 529.6X180/6= Rs1587.6

3. **Cost of Filters**:

1 coarse mesh filter and 2 FL-150 filter

Cost of mesh filter= Rs.15

Cost of 2 FL filter = 7000X2=Rs 14000

4. **Cost of labor:**

Tank Size- 2mX1.5mX0.5 will be built in 4 days

Cost of Masons= Rs 500/day

Cost of 2 masons= Rs. 1000/day

Cost of masons for 4 days= Rs 4000

Cost of majdoor=Rs.300/day

Cost of 4 majdoor=1200/day

Cost of majdoor for 4 days= Rs 4800

Total Labor Cost= Rs 8800

5. **Cost of syntax tanks:**

Two tanks are used

Cost of one tank=Rs 5500

Cost of 2 Tanks= Rs 11000

Total cost= 22756+1587+14015+8800+11000

TOTAL COST= Rs 58,158

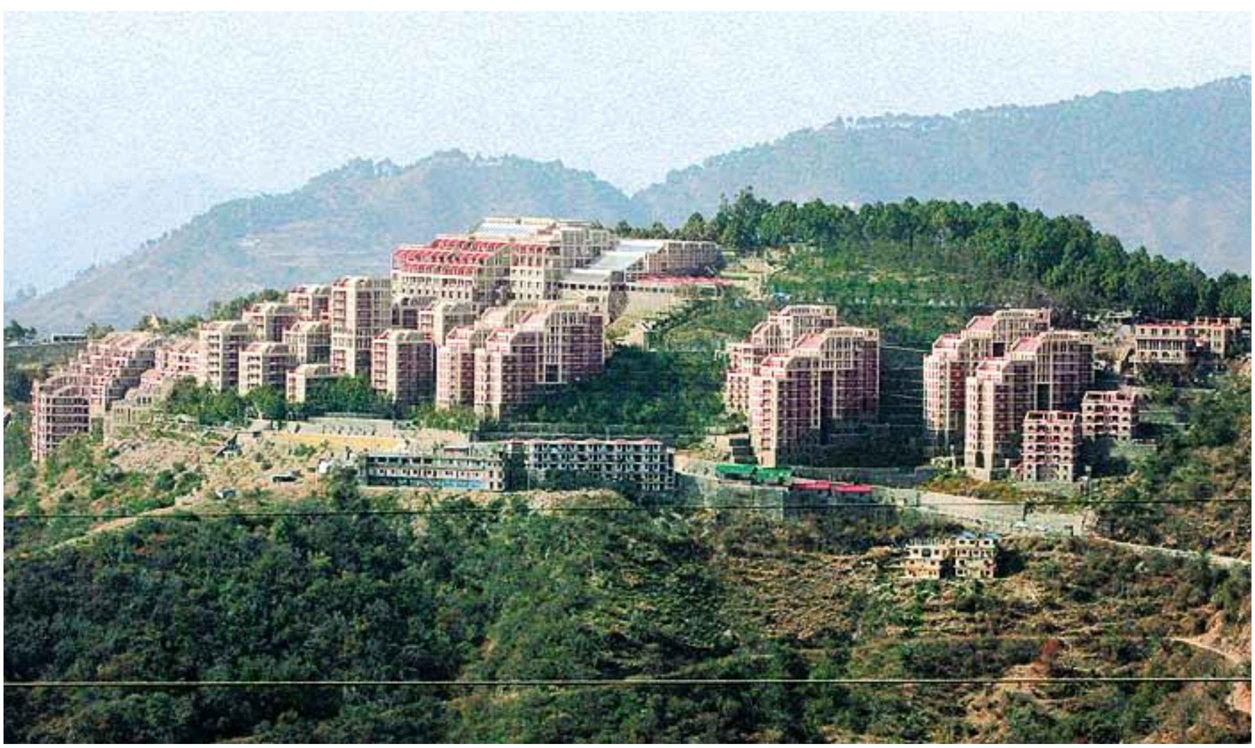
Case Study 2

JUIT Waknaghat

Project Site

Jaypee University of Information Technology is situated in the hilly terrain of Waknaghat Distt Solan (H.P). JUIT population is around 3500 comprising of students, faculty, workers and staff. It is an average rainy area. Rains are most common in months of July, August and September. To cater to the water needs of this institution the demand for water is being partially met by water tankers and rest by pump house situated at Domehar Bani situated 3Kms from JUIT. The excess rain water can also be utilized as a source to meet the demand of people in the campus.

In this Project we will design a Rainwater Harvesting System for JUIT and we will compare it with the RWHS that was designed for Delhi Region.



Source: google images **Fig.4.5**

Considering the 4 blocks i.e. A, B, C, D the calculations are as follows:

A block - 7 flats

Fig. 4.6 A- block

B block – 24 flats

Fig.4.7 B-block

C block – 21 flats

D block – 20 flats

Fig. 4.8 D block

Total Flats = 72

Average number of persons residing in a flat = 4

Total number of persons in all blocks = 288

4.2.1 Catchment

- Area utilized for Rainwater harvesting
    - Roof Area

Area of roof = 36 X 27 sq. ft

No. of roofs = 10

Total roof area = 36 X 27 X 10 = 9720 sq. ft

- Balcony Area

3 Balconies of area 8.5 X 27 = 229.5 sq. ft

1 Balcony of area 8.5 X 27 – 2 X 17 = 195.5 sq. ft

For A block = (3 X 229.5) + (1X195.5) = 884 sq. ft

For B block = (12 X 229.5) + (4 X195.5) = 3536 sq. ft

For C block = (9 X 229.5) + (3X195.5) = 2652 sq. ft

For D block = (6 X 229.5) + (2 X195.5) = 1768 sq. ft

Total Balcony area = 8840 sq. ft

Total Catchment area = 18560 sq. ft = 1724 m^2

- Runoff coefficient 0.80
- Evaporation coefficient 0.85

Average Monthly Rainfall

Table.4.3

Months	Rainfall (mm) (1900-2009)
Jan	39.19
Feb	42.86
March	36.73
April	31.5
May	37.55
June	125.13
July	253.99
Aug	226.51
Sept	138.31
Oct	18.4
Nov	11.14
Dec	15.58

So, total average annual rainfall is 977 mm approx

Average annual rainfall = 977mm

Total water that can be harvested= 0.80 X 0.85 X 1724 X0.977

Total harvested water = 1145356L

4.2.2 Water Demand in JUIT

Case-1

Assuming water demand = 150 lpcd

- For A block

Monthly Demand = 7X4X150X30= 126000L

Annual Demand = 7X4X150X30X11 = 1386000L

- For B block

Monthly Demand = 24X4X150X30= 432000L

Annual Demand = 24X4X150X30X11 = 4752000L

- For C block

Monthly Demand = 21X4X150X30= 378000L

Annual Demand = 21X4X150X30X11 = 4158000L

- For D block

Monthly Demand = 20X4X150X30= 360000L

Annual Demand = 20X4X150X30X11= 3960000L

So, Total Monthly Demand= 1296000L

Total Annual Demand= 14256000L

As the amount of water harvested is much less then the annual demand so this water can be used only for some specific domestic use such as for sanitation, washing etc.

Case- 2

Assuming Daily Demand =30+10 = 40 lpcd (as 150lpcd is not feasible)

- For A block

Monthly Demand = 7X4X40X30= 33600L

Annual Demand = 7X4X40X30X11 = 369600L

- For B block

Monthly Demand = 24X4X40X30= 115200L

Annual Demand = 24X4X40X30X11 = 1267200L

- For C block

Monthly Demand = 21X4X40X30= 100800L

Annual Demand = 21X4X40X30X11 = 1108800L

- For D block

Monthly Demand = 20X4X40X30= 96000L

Annual Demand = 20X4X40X30X11= 1056000L

So, Total Monthly Demand= 345600L

Total Annual Demand= 3801600L

4.2.3 Water Supply in JUIT

- Natural Water supply of JUIT is 2,00,000 litres (from domehar bani) , remaining is supplied through tankers including private and jaypee owned.
- Average Tanker = 10 per day
- Capacity of each tanker = 10000 litres

Amount of water supplied through tankers is 100000 per day

4.2.4 Mass inflow Curve:

Curve is the plot of accumulated inflow (i.e. Supply) or outflow (i.e. demand) vs time. The mass curve of supply (i.e. Supply line) is therefore first drawn and is superimposed by demand curve.

For computational convenience two cases were considered:

Case 1: When water consumption is assumed to be 150lpcd

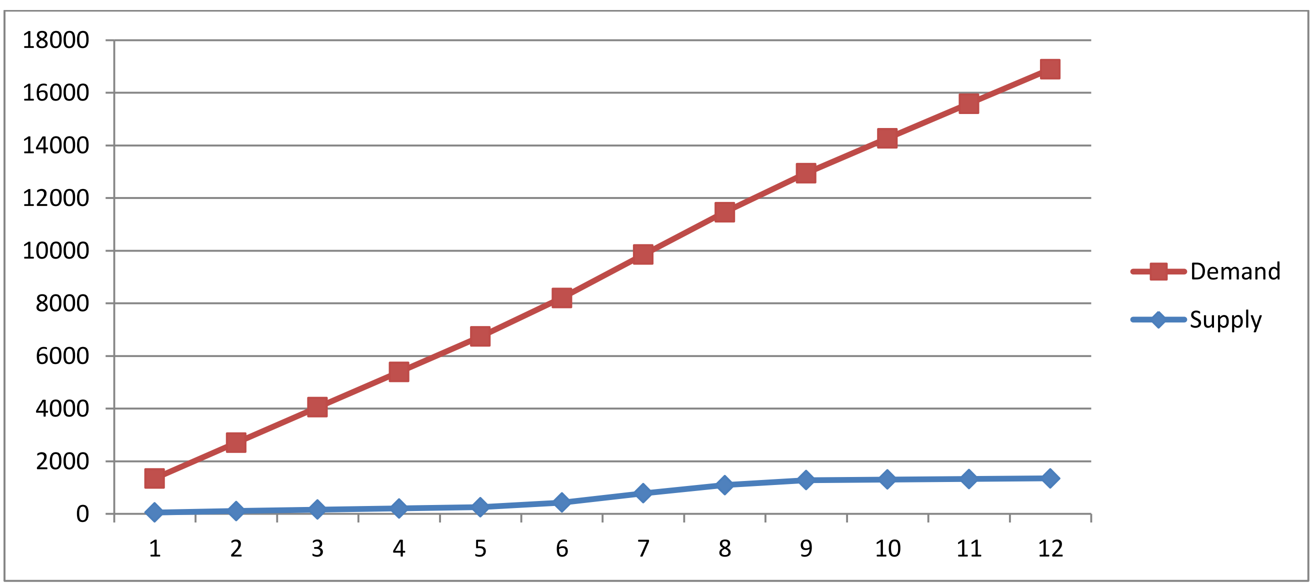
Case 2: When water consumption is assumed to be 40lpcd (for sanitation and washing purpose)

Case 1: When water consumption is assumed to be 150lpcd

Table 4.4

Month	Rainfall(mm)	Runoff(cu.m)	Cumulative Runoff(cu.m)	Demand(cu.m)	Cumulative Demand(cu.m)
Jan	39.19	54.050848	54.050848	1296	1296
Feb	42.86	59.112512	113.16336	1296	2592
March	36.73	50.658016	163.821376	1296	3888
Apr	31.5	43.4448	207.266176	1296	5184
May	37.55	51.78896	259.055136	1296	6480
June	125.13	172.579296	431.634432	1296	7776
July	253.99	350.303008	781.93744	1296	9072
Aug	226.51	312.402592	1094.340032	1296	10368
Sept	138.31	190.757152	1285.097184	1296	11664
Oct	18.4	25.37728	1310.474464	1296	12960
Nov	11.14	15.364288	1325.838752	1296	14256
Dec	15.58	21.487936	1347.326688	1296	15552

According to the data mentioned above the mass curve obtained is (Graph 4.4)



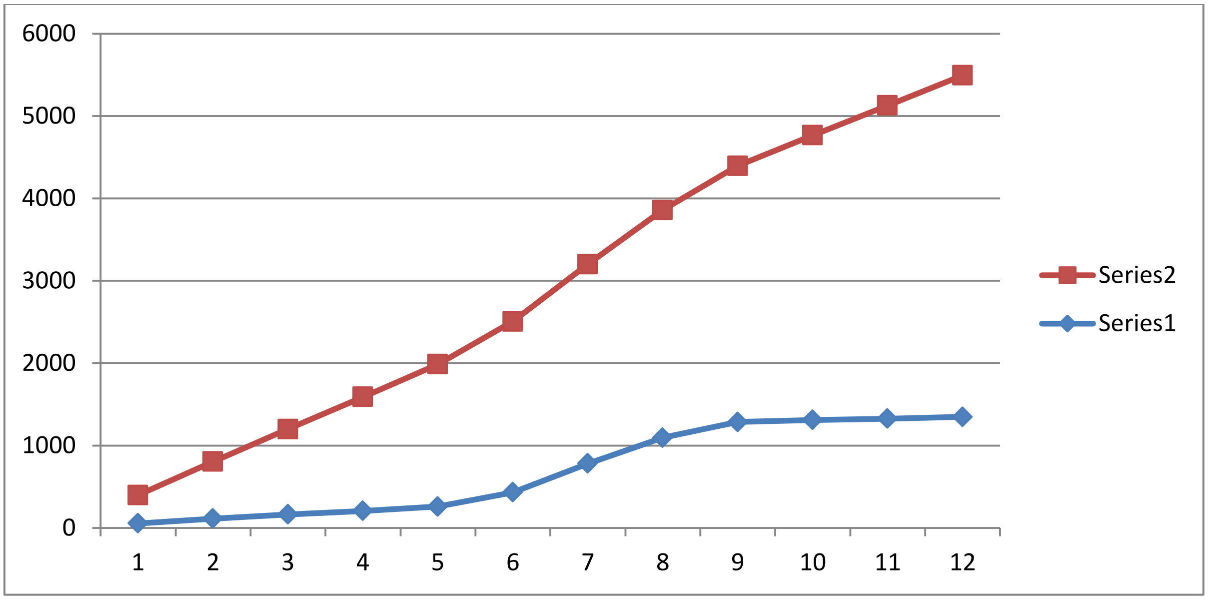
The mass curve obtained above is not feasible as the water demand is much greater than the water supplied or harvested. So, we have to use the rain water for other house hold purpose like sanitation, washing etc.

Case 2: When water consumption is assumed to be 40lpcd (for sanitation and washing purpose)

Table 4.5

Month	Rainfall(mm)	Runoff(cu.m)	Cumulative Runoff(cu.m)	Demand(cu.m)	Cumulative Demand(cu.m)
Jan	39.19	54.05085	54.050848	345.6	345.6
Feb	42.86	59.11251	113.16336	345.6	691.2
March	36.73	50.65802	163.821376	345.6	1036.8
Apr	31.5	43.4448	207.266176	345.6	1382.4
May	37.55	51.78896	259.055136	345.6	1728
June	125.13	172.5793	431.634432	345.6	2073.6
July	253.99	350.303	781.93744	345.6	2419.2
Aug	226.51	312.4026	1094.340032	345.6	2764.8
Sept	138.31	190.7572	1285.097184	345.6	3110.4
Oct	18.4	25.37728	1310.474464	345.6	3456
Nov	11.14	15.36429	1325.838752	345.6	3801.6
Dec	15.58	21.48794	1347.326688	345.6	4147.2

According to the data given above the mass curve obtained is as follows:



Graph.4.5

For the month for June, July, August, sep0embert the supply is more than that of demand. So, this is the case of overflow. Storage tank is required in this case.

4.2.5 Characteristics of Rainwater

Various quality parameter testing has been done on the rainwater and the following result has been obtained:

1. **pH-** pH is defined as the negative logarithmic of hydrogen or hydroxyl in concentration.. The pH test is an important preliminary test. Small changes in pH (0.3 units or even less) are usually associated with relatively large changes in other water qualities. pH measurement can be done by potentiometer and also by color indicator phenolphthalein and methyl orange. natural waters will have pH values from pH 5.0 to pH 8.5.

2. **Turbidity**: Turbidity is a measure of water clarity how much the material suspended in water decreases the passage of light through the water

3. **Hardness:** Hardness refers to the amount of mineral content present in water.

4. **Alkalinity:** Alkalinity is the measurement of acid neutralizing capacity of water. The compounds in water that determine alkalinity includes carbonate and bicarbonate ions. Maximum permissible value of alkalinity of drinking water is 200 mg/l

5. **Acidity:** Acidity is the measurement of base neutralizing capacity of water.

6. **TDS: Total** Dissolved solids is a measure of combined content of all inorganic and organic substances contained in water. Maximum permissible value of TDS of drinking water is 500 mg/l

7. **Chloride Content:** Amount of chlorine present in water. Maximum permissible value of chlorine in drinking water is 200 mg/l

Table.4.6 Characteristics of Water

S.no	Test	Result	Prescribed Value
1	pH	7.2	6.6 to 8.5
2	Turbidity	8 NTU	5 to 10 NTU
3	Hardness	46.5 mg/l	75 to 200 mg/l
4	Alkalinity	50 mg/l	200(max)
5	Acidity	0 mg/l	
6	TDS	10 mg/l	500mg/l(max)
7	Chloride content	1.2mg/l	upto250mg/l

4.2.6 Storage Tank

General Requirement of storage tank of Storage tank (Indian Standard Code 14961:2001)

The following Requirement should be considered for designing/installing/operating the system, although the choice of tank depends on locally available material and space available

1. The tank should be located on slope which is structurally stable. In case the slope is in the distress adequately safety measures are required to be taken before installation of tank

2. The size of tank will depend upon factors like daily demand, duration of dry spell, catchments area and rainfall.

3 The downpipe should be of at least 100mm diameter with 20 mesh nylon wire screens at the inlet to prevent dry leaves and debris from entering in it.

4. Dust, bird droppings, etc accumulated on the roof during the period of no rain and washed off with the first rains shall not be allowed to enter the storage tank to contaminate the water. This can be prevented by two methods:

i) Simple Diversion of foul water – Under this method, the down pipe is moved away from the inlet of storage tank initially during the rains, until clean water flows

ii) Installation of foul flush system- Under this method, storage provision for initial rain is kept in pipe. These are cleaned after each heavy rain. These are provided down pipe and storage tank.

5. Filter material such as gravel, sand, coconut, palm etc should be used as filter material.

6. Underground storage tanks should be suitably lined with water proofing material and preferably have a hand pump installed for withdrawal of water

7. The following provisions should be made:

i) A manhole 600X600 mm square or 600 mm dia with cover.

ii) Vent/overflow pipe with 100 mm dia

iii) Drain pipe at the bottom

8. In order to avoid any instability of slope, excess water should be drained to the nullah for any other natural drain or disposed through a properly designed outlet system.

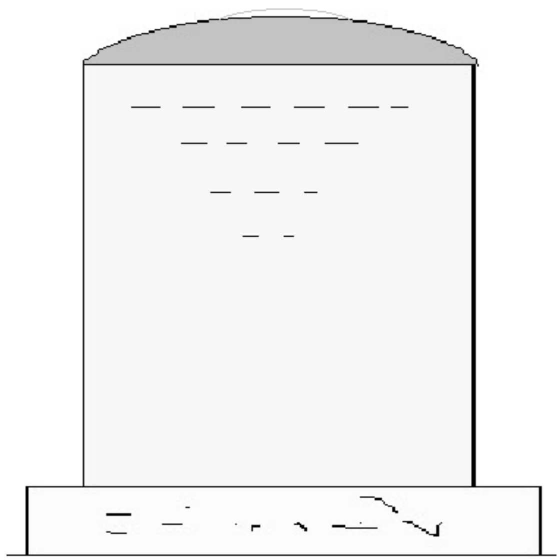


Fig.4.9

4.2.7 Dimension of tank: (As per BS 8515 2009)

The size of tank depends upon the factor like daily demand, duration of dry spell, catchment and rainfall.

For each block there will be separate tank

- **A block-**

Annual Demand = 369600L

Annual Supply = 0.80*172.42*.977= 134763L

The Capacity of storage tank is = 5% of Annual Demand or 5% of Annual supply

= 0.05*369600 or 0.05*134763

= 18.48cu.m or 6.75cu.m

Taking the minimum value, Size of Tank is 6.75cu.m

Dimension of tank= 3mX1.5mX1.5m

- **B block-**

Annual Demand = 1267200L

Annual Supply = 0.80*689.7*.977= 539070L

The Capacity of storage tank is = 5% of Annual Demand or 5% of Annual supply

= 0.05*1267200 or 0.05*539070

= 63.36cu.m or 26.95cu.m

Taking the minimum value, Size of Tank is 26.95=27cu.m

Dimension of tank= 6mX3mX1.5m

- **C block-**

Annual Demand = 1108800L

Annual Supply = 0.80*517.28*.977= 404310L

The Capacity of storage tank is = 5% of Annual Demand or 5% of Annual supply

= 0.05*1108800 or 0.05*404310

= 55.44cu.m or 20.20cu.m

Taking the minimum value, Size of Tank is 20.20= 20cu.m

Dimension of tank= 5mX2mX2m

- D block-

Annual Demand = 1056000L

Annual Supply = 0.80*344.85*.977= 269535L

The Capacity of storage tank is = 5% of Annual Demand or 5% of Annual supply

= 0.05*1056000 or 0.05*269535

= 52.80cu.m or 13.47cu.m

Taking the minimum value, Size of Tank is 13.40cu.m

Dimension of tank= 4.75mX2.25mX1.25m

Table.4.7 Dimension of tanks

Block	Capacity (cu.m))	Dimension of tank
A	6.75	3mX1.5mX1.5m
B	27	6mX3mX1.5m
C	20	5mX2mX2m
D	13.4	4.75mX2.25mX1.25

Alternate method to calculate the Dimension of tank

- **For block A**

Based on dry period i.e. the period between two consecutive rainy seasons, for a monsoon extending over four months, the dry season is of 245 days

Calculate the drinking water requirement of building= 10*245*28=68600L

For safety factor, tank should be constructed 20% larger than required i.e. 82320L

This tank can meet the basic drinking water requirement of a 28-member for the dry period. A typical size of a rectangular tank constructed will be about 82.32cu.m i.e.82.50cu.m

Dimension of tank = 10mX5.5mX1.5m

Similarly by following the above procedure the dimensions of various tanks comes out to be

Table 4.8

Block	Capacity (cu.m)	Dimension of tank
A	82.5	10mX5.5mX1.5m
B	282	10mX6.5mX4.5m
C	250	10mX5mX5m
D	235	9mX5.25mX5m

4.2.8 Cost Estimation

1. Cost of construction of tank

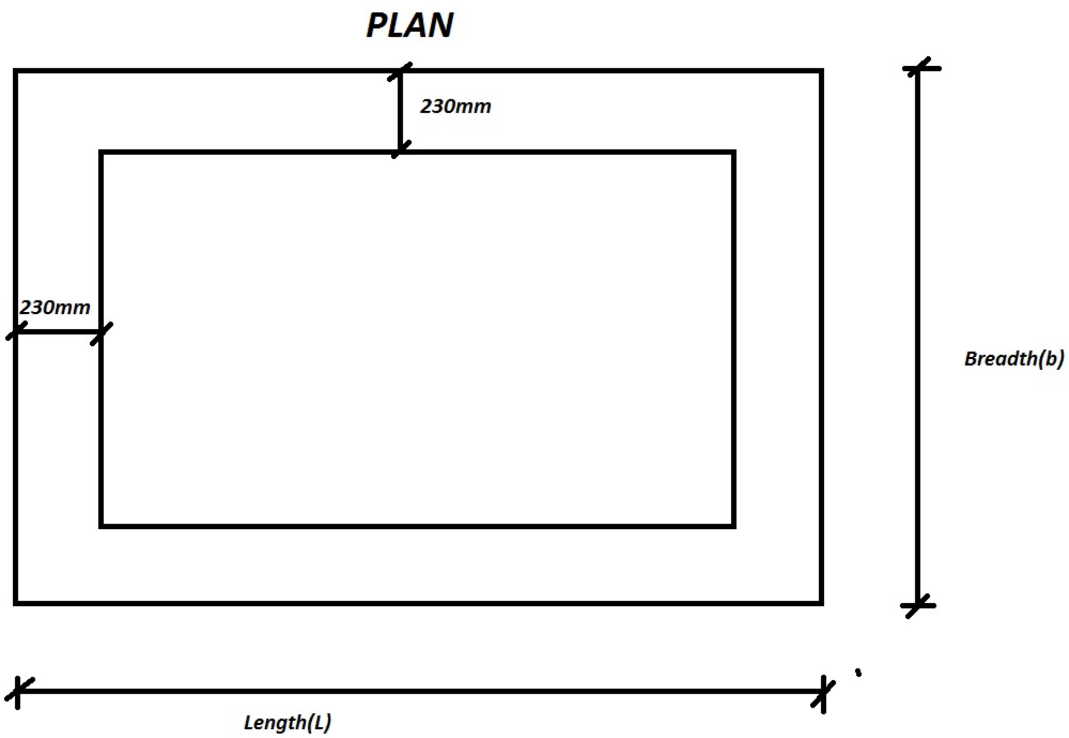


Fig4.10

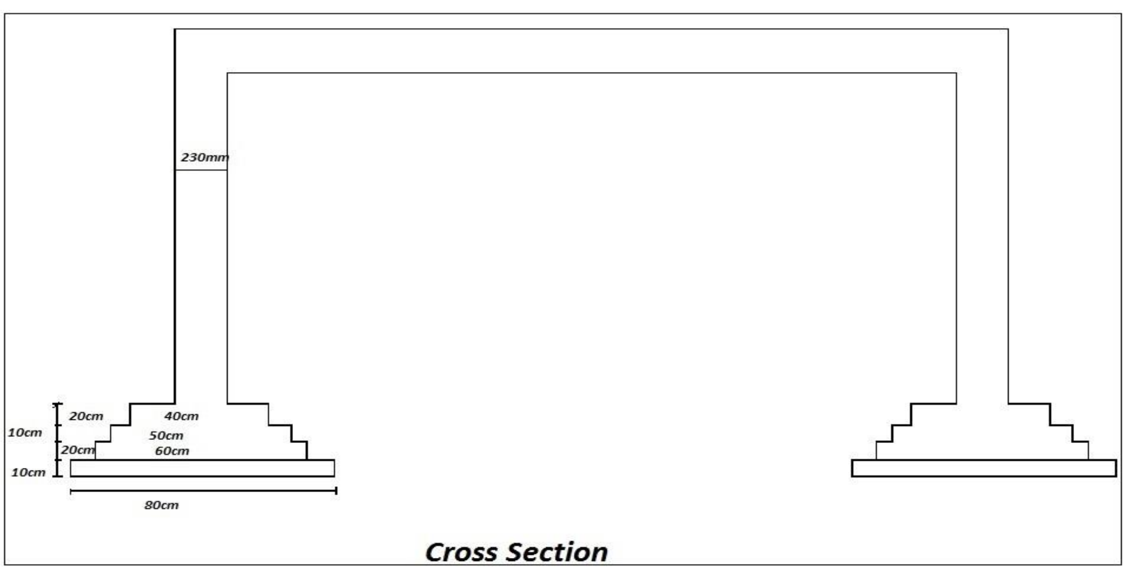


Fig 4.11

- **For A Block:**

Tank Dimension – 3mX1.5mX1.5m

Length of long walls = 2 X 3.23

Length of short wall = 2 X 1.73

Total= 9.92

S.No	Description	Length(m)	Breadth(m)	Height(m)	Quantity(cu.m)
1	Excavation of				
	a) Foundation of tank	9.92	0.8	0.6	4.7616
	b) Tank Wall	3.46	1.96	1.5	10.1724
				Total	14.934
2	PCC in foundation	9.92	0.8	0.1	0.7936
3	Brickwork				
	a) Step 1	9.92	0.6	0.2	1.1904
	b) Step 2	9.92	0.5	0.1	0.496
	c) Step 3	9.92	0.4	0.2	0.7936
	d) Wall above footing	9.92	0.23	1.5	3.4224
				Total	5.9024
4	Cement Plaster (12mm)in				Sqm
	a)Inside Plaster				
	i) Long wall (2 nos)	2X3	1.5		9
	ii) Short wall (2 nos)	2X1.5	1.5		4.5
	b) Outer Plaster				
	i) Long Wall (2 nos)	2X3.46	1.5		10.38
	ii) Short Wall (2 nos)	2X1.96	1.5		5.88
				Total	29.76

Table 4.9(a)

Abstract of estimated cost

Item No.	Particular of items of work	Quantity	Unit	Rate	Amount
1	Excavation in foundation & Tank	14.943	cu.m	100	1494.3
2	Brickwork	5.9024	cu.m	6500	38365.6
3	PCC	0.7936	cu.m	3600	2856.96
4	Cement Plaster	29.76	sq.m	135	4017.6
				Total	46734.46

Table 4.9(b)

- **For B Block:**

Tank Dimension = 6mX3mX1.5m

Length of long walls = 2 X 6.23

Length of short wall = 2 X 3.23

Total= 18.92m

S.No	Description	Length(m)	Breadth(m)	Height(m)	Quantity(cu.m)
1	Excavation of				
	a) Foundation of tank	18.92	0.8	0.6	9.0816
	b) Tank Wall	6.46	3.46	1.5	33.5274
				Total	42.609
2	PCC in foundation	18.92	0.8	0.1	1.5136
3	Brickwork				
	a) Step 1	18.92	0.6	0.2	2.2704
	b) Step 2	18.92	0.5	0.1	0.946
	c) Step 3	18.92	0.4	0.2	1.5136
	d) Wall above footing	18.92	0.23	1.5	6.5274
				Total	11.2574

4	Cement Plaster (12mm)in				sq.m
	a)Inside Plaster				
	i) Long wall (2 nos)	2X6	1.5		18
	ii) Short wall (2 nos)	2X3	1.5		9
	b) Outer Plaster				
	i) Long Wall (2 nos)	2X6.46	1.5		19.38
	ii) Short Wall (2 nos)	2X3.46	1.5		10.38

Table 4.10(a)

Abstract of estimated cost

Item No.	Particular of items of work	Quantity	Unit	Rate	Amount
1	Excavation in foundation & Tank	42.61	cu.m	100	4261
2	Brickwork	11.26	cu.m	6500	73190
3	PCC	1.5136	cu.m	3600	5448.96
4	Cement Plaster	56.76	sq.m	135	7662.6
				Total	**90562.56**

Table 4.10(b)

- **For C Block:**

Tank Dimension = 5mX2mX2m

Length of long walls = 2 X 5.23

Length of short wall = 2 X 2.23

Total= 14.92m

S.No	Description	Length(m)	Breadth(m)	Height(m)	Quantity(cu.m)
1	Excavation of				
	a) Foundation of tank	14.92	0.8	0.6	7.1616
	b) Tank Wall	5.46	2.46	2	26.8632
				Total	34.0248
2	PCC in foundation	14.92	0.8	0.1	1.1936
3	Brickwork				
	a) Step 1	14.92	0.6	0.2	1.7904
	b) Step 2	14.92	0.5	0.1	0.746
	c) Step 3	14.92	0.4	0.2	1.1936
	d) Wall above footing	14.92	0.23	2	6.8632
				Total	10.5932
4	Cement Plaster (12mm)in				sq.m
	a)Inside Plaster				
	i) Long wall (2 nos)	2X5	2		20
	ii) Short wall (2 nos)	2X2	2		8
	b) Outer Plaster				
	i) Long Wall (2 nos)	2X5.46	2		21.84
	ii) Short Wall (2 nos)	2X2.46	2		9.84
				Total	59.68

Table 4.11(a)

Abstract of estimated cost Table 4.11(b)

Item No.	Particular of items of work	Quantity	Unit	Rate	Amount
1	Excavation in foundation & Tank	34.02	cu.m	100	3402
2	Brickwork	10.586	cu.m	6500	68809
3	PCC	1.19	cu.m	3600	4284
4	Cement Plaster	59.68	sq.m	135	8056.8
				Total	**84551.8**

For D Block:

Tank Dimension = 4.75mX2.25mX1.25m

Length of long walls = 2 X 4.98

Length of short wall = 2 X 2.48

Total= 14.92m

S.No	Description	Length(m)	Breadth(m)	Height(m)	Quantity(cu.m)
1	Excavation of				
	a) Foundation of tank	14.92	0.8	0.6	7.1616
	b) Tank Wall	5.21	2.71	1.25	17.648875
				Total	24.810475
2	PCC in foundation	14.92	0.8	0.1	1.1936
3	Brickwork				
	a) Step 1	14.92	0.6	0.2	1.7904
	b) Step 2	14.92	0.5	0.1	0.746
	c) Step 3	14.92	0.4	0.2	1.1936
	d) Wall above footing	14.92	0.23	1.25	4.2895
				Total	8.0195
4	Cement Plaster (12mm)in				sq.m
	a)Inside Plaster				
	i) Long wall (2 nos)	2X4.75	1.25		11.875
	ii) Short wall (2 nos)	2X2.25	1.25		5.625
	b) Outer Plaster				
	i) Long Wall (2 nos)	2X5.21	1.25		13.025
	ii) Short Wall (2 nos)	2X2.71	1.25		6.775
				Total	37.3

Table 4.12(a)

Abstract of estimated cost

Item No.	Particular of items of work	Quantity	Unit	Rate	Amount
1	Excavation in foundation & Tank	24.81	cu.m	100	2481
2	Brickwork	8.016	cu.m	6500	52104
3	PCC	1.19	cu.m	3600	4284
4	Cement Plaster	37.3	sq.m	135	5035.5
				Total	**63904.5**

Table 4.12(b)

So, the total cost of construction of tank=Rs 285751

2. Cost of pipes:

- **For A Block-**

Total Flats= 7

Length of main pipe= 90ft

Pipe length required for balcony (Since Balcony are in stepped manner)

Total no. of balconies = 4

Length of pipe for top most balcony = 12ft

Length of pipe for 2nd balcony from top= 9ft

Length of pipe for 3rd balcony from top= 6ft

Length of pipe for 4th balcony from top=3ft

Total length of pipe required= 30+90= 120ft= 36.576m

Cost of 6m pipe = Rs 529.20

Cost of 36.576m pipe= 529.20X36.576/6

Total Cost of pipe = Rs.3226

- ## For B Block-

Total Flats= 24 (6 flats in each tower)

Length of main pipe= 4X80=320ft

Pipe length required for balcony (Since Balcony are in stepped manner)

Total no. of balconies in 1 tower = 4

Length of pipe for top most balcony = 12ft

Length of pipe for 2nd balcony from top= 9ft

Length of pipe for 3rd balcony from top= 6ft

Length of pipe for 4th balcony from top=3ft

Total length of pipe required for balconies= 30X4=120ft

Total length of pipe required= 120+320= 440ft=134.112m

Cost of pipe is Rs 529.20 for 6m

Cost of pipe required= 134.112X529.20/6

Total Cost= Rs.11,828

- ## For C Block-

Total Flats= 21 (7 flats in each tower)

Length of main pipe= 90X3=270ft

Pipe length required for balcony (Since Balcony are in stepped manner)

Total no. of balconies in 1 tower = 4

Length of pipe for top most balcony = 12ft

Length of pipe for 2nd balcony from top= 9ft

Length of pipe for 3rd balcony from top= 6ft

Length of pipe for 4th balcony from top=3ft

Total length of pipe required for balconies= 30X3=90ft

Total length of pipe required= 90+270= 360ft=109.7272m

Cost of pipe is Rs 529.20 for 6m

Cost of pipe required= 109.7272X529.20/6

Total Cost= Rs.9678

- **For D Block-**

Total Flats= 20 (10 flats in each tower)

Length of main pipe from one roof= 120ft

Length of main pipe= 120X3=240ft

Pipe length required for balcony (Since Balcony are in stepped manner)

Total no. of balconies in 1 tower = 4

Length of pipe for top most balcony = 12ft

Length of pipe for 2nd balcony from top= 9ft

Length of pipe for 3rd balcony from top= 6ft

Length of pipe for 4th balcony from top=3ft

Total length of pipe required for balconies= 30X2=60ft

Total length of pipe required= 60+240= 300ft=91.44m

Cost of pipe is Rs 529.20 for 6m

Cost of pipe required= 91.44 X 529.20 /6

Total Cost= Rs.8065

So, the total cost of pipes= Rs 32,797

3. Cost of filters used:

Filter units used are Coarse Mesh Filter & FL Filter

For A Block – 1 Coarse mesh Filter and 2 FL Filter units are used

For B Block – 4 Coarse mesh Filter and 8 FL Filter units are used

For C Block – 3 Coarse mesh Filter and 6 FL Filter units are used

For D Block – 2 Coarse mesh Filter and 4 FL Filter units are used

Cost of 1 Coarse mesh filter = Rs 15

Total Cost of 10 Coarse mesh filter = Rs 150

Cost of 1 FL-150 filter Unit= Rs.7000

Total Cost of 20 FL-150 filter Unit= Rs.140000

So, the total cost of filters=Rs 140150

4. Labor Cost:

Cost of Masons = Rs 500/day

Cost of Majdoor= Rs 300/day

Two masons, Four Majdoor

- **For A block:**

Tank of Size – 3mX1.5mX1.5m will be built in 6 days

Cost of majdoors= 4X300X6= Rs 7200

Cost of Masons= 2X500X6=Rs 6000

- **For B block:**

Tank of Size – 6mX3mX1.5m will be built in 9 days

Cost of majdoors= 4X300X9= Rs 10800

Cost of Masons= 2X500X9=Rs 9000

- **For C block:**

Tank of Size – 5mX2mX2m will be built in 7days

Cost of majdoors= 4X300X7= Rs 8400

Cost of Masons= 2X500X7=Rs 7000

- **For D block:**

Tank of Size –4.75mX2.25mX1.25m will be built in 6 days

Cost of majdoors= 4X300X6= Rs 7200

Cost of Masons= 2X500X6=Rs 6000

So, the total Labor Cost= Rs 61600

Conclusion

Rainwater harvesting is accumulation and deposition of rainwater for reuse before it reaches the aquifer.

We all know water is one of the most important natural resource. It is the most basic needs for all living beings as well as a very valuable national asset. In India, water availability per capita is on decline with most obvious reasons as increasing demand for water with increasing rate of population. The increased demand has not been matched by efforts to conserve and better manage water supply. India faces a bleak water future. India might face a severe water crisis within the next two decades, unless water management practices are changed or improved on priority basis. That is why we decided to do this project.

Our Project objective is to develop Rain water harvesting system for two sites

- Mahaluxmi complex in Delhi
- JUIT in Waknaghtat Solan (H.P)

We took these two sites because both the sites are different in geographical features. One is in plane region which receives lesser amount of rainfall (700mm annually) and the other is in hilly region which receives comparatively higher amount of rainfall (977mm annually).

Since we were not able to meet all the water requirement of residents in both the cases, So we designed our Rain water harvesting system to meet the sanitation and washing requirement of residents.

In first Case study of Mahaluxmi complex, demand for sanitation and washing is 2336000L (annually) and supply through designed rain water harvesting system is 285600L (annually). So we can meet about 12.2% of the demand through our designed system. The rest of the demand will be met through the municipal water supply.

In Second case study of JUIT, demand for sanitation and washing is 3801600L (annually) and supply through designed rain water harvesting system is 1357678L (annually).). So we can meet about 35.4% of the demand through our designed system. The rest of the demand will be met through the tankers and the regular water supply from the Dumehar Bani.

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