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A Project Report on the Construction of a Rooftop Rainwater Harvesting System for a College

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Abstract: In order to conserve water for the future and replenish groundwater supplies, rainwater harvesting (RWH) is a fantastic practise. Both surface and groundwater supplies in India are rapidly declining because of the country's burgeoning population, the effects of global warming, the inequitable distribution of rainfall, and the often-severe fluctuations in other meteorological indices. As a result, it's crucial that people everywhere start taking steps to conserve water on their own, in their schools, and in their neighbourhoods. The purpose of this research project was to create plans for a rainwater harvesting system on the roof of the Dhaanish Ahmed College of Engineering in Chennai, which is in the Indian state of Tamil Nadu. After analysing the water needs and available supplies on campus, the administration decided that the main building would provide the best catchment area for collecting rainwater for reuse. In addition, the RWH system's many components were developed using industry standards. Based on the results of the study, it was determined that if the RWH system were installed on the campus of the Dhaanish Ahmed College of Engineering in Chennai, it would be possible to store enough water over the course of a year to alleviate the College's water scarcity issues during the dry season. With this plan in place, there will be more water available for building and cultivation. It will assist artificially recharge groundwater, which will improve water quality in both the surface and subsurface. Dhaanish Ahmed College of Engineering, Padappai garden grounds and roof tops are included in the construction plan and implementation. Total roof surface area is 81706.38 square feet. IS 15797: 2008, "Indian Standards for Rooftop Rainwater Harvesting Guidelines," was used as inspiration for the design.

Keywords: Installation, Rooftop, Rainwater Harvesting, structure, College Campus,

Introduction

As a result of rapid urbanisation, human density has increased in many areas, leading to a scarcity of both surface water and uneven drying of groundwater. Because of this, areas with heavy industrial and domestic water demand are experiencing drought and river bed drying up. Collecting rainwater and reusing stormwater flow can help ensure that future generations don't go thirsty [4]. Recharging the groundwater supply is the optimal method of rainwater gathering. Rainwater that collects in abandoned ponds or tanks can also be used to recharge the natural aquifer and increase the quantity of groundwater available. Rooftop rain harvesting refers to the process of collecting rainwater from catchments on roofs [5]. Rainwater can be collected and stored in tanks below ground using artificial recharge techniques to meet household water demands [6]. A fundamental problem in the design of a rainwater collecting system is determining how much space will be needed to store the collected water, which is true in both rural and urban areas. Rainfall should be collected efficiently for the intended use by strategically planning the catchment area [1]. Located in the heart of Chennai, the Dhaanish Ahmed College of Engineering boasts a sprawling 30-acre campus [7]. There are around 1,500 full-time students living on the main campus. This raises the prospect of a water deficit in the years to come. Rapid extraction of water from local aquifers is an everyday occurrence. There are more fields in the vicinity that could use this water. As a result, we now have an opportunity to collect and reuse rainwater. This expansive area has a lot of potential for rainwater collection. There are ample options to collect rainwater in this part of Padappai, since the area receives an average of 3017 millimetres of precipitation per year, with an intensity of 20 millimetres per hour [9]. The purpose of this research is to develop a plan for a rainwater harvesting system to be installed on the roof of Dhaanish Ahmed College of Engineering during the dry months. These were the goals of the research project [1]:

- The goal is to calculate the average daily water use at the College for both academic and administrative purposes.
- The goal is to calculate how much water may be collected from the campus's catchment regions using rainwater

collection.

- Creating a system to collect rainwater from roofs for use on campus.

History of Rain Water Harvesting

There is evidence of water collection and use systems, including rooftop catchment systems, dating back to early Roman times. Roman estates and entire urban populations were planned around water as the primary water source for drinking and residential needs for at least two thousand years before the common era [10]. Tanks for storing runoff from slopes for domestic and agricultural use have made it possible to live and flourish in the Negev region of Israel, despite the region's low annual rainfall of 100 millimetres. The earliest evidence of the technology's use in Africa dates back at least 2,000 years to northern Egypt, where tanks with capacities ranging from 200 to 2,000 m3 have been in use, and many of them are still in use today [12]. Similarly, in Asia, water harvesting hones have been followed for over 2000 years in Thailand, therefore the technology has a lengthy history there as well. Over the years, people in Africa and Asia have perfected the art of collecting water in little quantities from the overhang of rooftops or by employing easy drains into traditional jugs and pots [13]. Many outlying provincial areas still use this method today. Istanbul, Turkey's Yerebatan Sarayi possibly holds the title of largest water tank in the world. Caesar Justinian oversaw its construction (A.D. 527-565) [14]. The maximum volume is 80,000 cubic metres, and its dimensions are 140 by 70 metres [15].

Global And Indian Studies on Rainwater Harvesting

Nearly eighty-five percent of the waterfalls go directly into the ocean and never reach dry land. What little is left behind and rushes across the land fills the lakes and wells and fills the streams [16]. Only one gramme of fresh water is available to humans for every 50,000 grammes of seawater, making fresh water a very precious commodity. About 75% of the Earth's surface is covered by water. The total volume of water is estimated to be about 1400 million Km3, or enough to cover the entire planet with a layer 300 metres thick [17]. The oceans contain around 97.0 percent of this liquid. In the Polar Regions, a whopping 79% of the lies hardened, making up 3.0% of the total. This leaves just around 0.6% of the total made up of the rest of the water found in things like lakes and streams, underground storage facilities, and other forms of dampness in the air, soil, and vegetation. Only 53% of this 0.6% (fluid new water) is readily available as water from streams and lakes. Surprisingly, the salt water of the oceans is the world's most reliable source of fresh water [18].

The annual global hydrological cycle generates about 113,000 cu. km of new water, of which 72,000 cu. km is lost to evaporation and only 41,000 cu. km is usable [19]. Annually, India has access to a total of 2.085 million m3, compared to 6.949 million in Brazil, 9.465 million in Russia, 2.530 million in Indonesia, 2.478 million in the United States, and 2.480 million in China (2.427). Water conservation should be promoted in both established and emerging social structures [20]. Eighty percent of the water used in social order creation is in horticulture. In 2004, India's population had access to 2,000 cubic metres less of water than those in Canada (110,000), the United States (9,900), and Japan (4,400) [21]. These countries have been able to properly equip a sizable portion of their water resources because to careful management [22]. Water scarcity is a major problem in many parts of India, and we have failed to make proper use of our water resources. Constant water shortages have been plaguing the country since at least the 1990s, and the affected area is expected to grow significantly by 2025. The genuine need for water asset optimization is too important to ignore [23]. The appropriate management and utilisation of water resources has emerged as a major global concern, with far-reaching effects for population planning, welfare, social solidity, and peace. The demand for surface water is growing at an exponential rate today due to the increasing population and moderate rate of development [3]. This fact leads to the overuse of water sources, which eventually results in a global water shortage [24]. Here is a visual analysis showing where water scarcity was an issue in 1990 and where it will be an issue in 2025. (fig.1).

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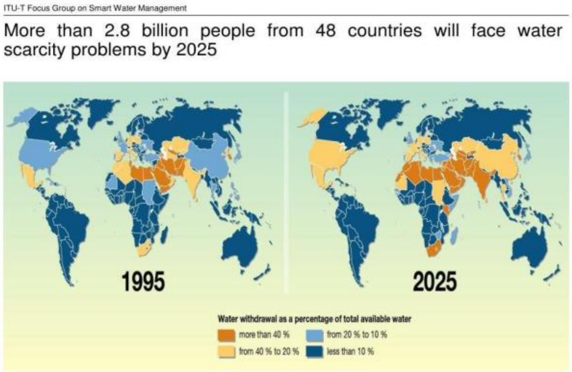

Figure 1: Water scarcity percentage in 1995 and 2025 [8]

The global assessment predicts that by the year 2025, India will be experiencing water scarcity [25]. As rising costs and new biological problems become more of a concern, water collection is a viable alternative to surface and groundwater [26]. Given our limited resources, water harvesting is a smart and relatively simple approach that ensures a steady long-term water supply for the community. With the purpose of alleviating the water crisis, many countries have started collecting rainwater [27]. The United States, Singapore, Japan, and Germany are all major players in the RWH industry. In Germany, the largest harvesting framework is located at Frankfurt Airport, collecting water from the tops of the new terminal, which has a huge catchment area of 26,800 m2. In Singapore, the average yearly precipitation is 2400 mm, making it ideal for water collecting applications [28]. In Japan, the RWH framework saves water that can be used for emergency water requests in the event of a seismic disaster [29].

Studies Carried Out in India

The proportion of fresh, usable water for human use, agriculture, and industry is only 2.5% of the total. Some parts of the world are draining their water supplies much quicker than they are being refilled by rain and snow. India's per capita water availability will drop from 5,000 cubic metres in 1950 to 1,500 cubic metres in 2025. The United Nations warns that a lack of freshwater may be the greatest obstacle to feeding the world's growing population, reducing poverty, and protecting the planet [30].

Ground Water Scenario of Tamil Nadu

Table 1: land survey of Tamil Nadu (Groundwater)

Area (Sq.km)	130058
Rainfall (mm)	995
Total Districts / Blocks	30 Districts / 384 Blocks

Hard and fractured crystalline rocks including Charnockite, Gneisses, and Granites cover over 73% of the State's total area (table 1). The water level in open wells might be anything between 6 and 30mbgl. Bore wells can be dug anywhere from 30 to 100 metres deep [31]. Quaternary sediments in the state include older alluvium, Recent alluvium, and coastal sands, while sedimentary rocks include sandstones, limestones, and shales [32-37]. The free flow rate in the Cauvery delta of the Thanjavur area is as high as 270 m3/hr, and the artesian pressure head varies from 4.5 m to 17 mbgl. Wells in the alluvium produce between 27 and 212 m3 per hour. Fissured formation wells produce anywhere between 7 and 35 m3/h (table 2).

Table 2: Dynamic Ground Water Resources of Tamil Nadu

Dynamic Ground Wat Resources	
Annual Replenishable Ground Water Resources	23.07 BCM
Net Annual Ground Water Availability	20.76 BCM
Annual Ground Water Draft	17.65 BCM
Stage of Ground Water Development	85%

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Enactment of Ground Water Bill to regulate and control the development of groundwater:

For the purpose of regulating and controlling water development in the State of Tamil Nadu, the Tamil Nadu State Government passed the "Tamil Nadu Ground Water (Development and Management) Act, 2003" on 04.03.2003. This Act includes the provision of the Tamil Nadu Ground Water Authority. The State Govt is currently thinking about how to frame the rules and constitution for the State Ground Water Authority. Any changes made to the Model Bill, 2005, that were recommended by MoWR will be implemented as soon as possible [38].

Inclusion of Roof Top Rain Water Harvesting (RTRWH) in the building by-laws:

The State's Municipal Corporations and Municipalities Ordinance No. 4 of 2003, issued July 2003, mandates that all new and renovated buildings within the state provide access to a RWH system. The state has begun rolling out the RWH plan across the board, including in public buildings, private residences and institutions, and public and private businesses in both urban and rural locations. The State Administration has completed its goal of complete rooftop RWH coverage [39-45].

Study Area

Padappai is a town in the Kanchipuram district of Tamil Nadu. Because of its proximity to Oragadam Industrial Park, it has a high population density. Humidity and precipitation are common throughout the monsoon months of June, July, August, and September. During this time of year, this region experiences significant rainfall [46-51]. The months of October and November have mild temperatures and nice conditions. Because of its proximity to Padappai town, the campus of Dhaanish Ahmed College of Engineering experiences heavy rains during the monsoon season and a dry spell for much of the rest of the year. This causes a campus-wide water shortage in the summer, which can be remedied by collecting rainwater from roofs. College buildings that can be used as catchment areas include the Main Building (Block A), Main Building (Block B), the Four Boy's Hostel Buildings (Block A, B, C, and D), and the Masjid Buildings. Below is a photo of the majority of the Dhaanish Ahmed College of Engineering in Chennai, India, where students are learning about and developing rainwater harvesting systems. Dhaanish Ahmed College of Engineering can be found at the coordinates 12°52'24.0" North, 79°59'41.1" East. Vanchuvanchery, Padappai, Dhaanish Nagar, Chennai 601301. In Figure 2, we see how a GIS can be used to (GIS) [52-55].

Figure 2: Dhaanish Ahmed College of Engineering, Chennai (Google map)

Methodology

From the Indian Meteorological Department, we gathered and analysed rainfall data for the study area throughout the period of 2001 to 2021. Researchers found that 1068.39 mm, on average, fell per year in the studied region. A systematic approach to designing a rainwater collection system is outlined. This research uses as its catchment regions the Main building (Block A), the Main building (Block B), the four Boys hostel buildings (Block A, B, C, and D), and the Masjid building. Dimensions such as floor size and building height were extrapolated from the provided floor plans. Using the logical formula, we were able to evaluate the overall potential for collecting rainwater and determine the total required amount of water. The final catchment area used in the design process was determined by these two factors [56-59].

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Components of Rainwater Harvesting System

Filtration, storage tanks, and conveyance funnels or depletes are all essential components of a water collection structure. A typical water collection system consists of A catchment zone is a surface that efficiently collects precipitation and distributes it throughout the system [60-67]. It can refer to a paved or unpaved area, such as a patio, yard, or open field. Water can be collected from a roof built of strengthened bond concrete (RCC), excited iron, or layered sheets [68].

Coarse Mesh: It contains the random debris that lands on the roof.

Pipes that collect rainwater and carry it to a storage tank around the sloping roof's perimeter. Most canals are constructed regionally out of plain, unpainted iron sheets and can be either semi-round or rectangular in shape. Drains need to be supported so that water does not pool and cause them to dangle or topple over [69-71]. The construction of the home will determine how the canals are installed; typically, iron or timber sections are put into the partitions [72-87].

Pipes or channels called conduits transport water from the catchment or roof top area to the collecting system. The most common components of easily accessible courses are polyvinyl chloride (PVC) and electric press (GI) [88-91].

To initiate the flushing process: A first flush device is a valve that ensures the first downpour is diverted away from the storage tank, where it would otherwise carry a relatively higher concentration of airborne and surface contaminants [92].

Water collected from rooftops can have suspended toxins removed by passing it through a channel. Business design often makes use of charcoal water channels, sand channels, horizontal roughing channels, and mild sand channels [93].

Room for storing things: Tanks can be built in a variety of shapes, sizes, and materials, and they can be placed in a variety of locations [94-95].

Cylindrical, square, and rectangular forms are all acceptable. Construction materials include RCC (reinforced concrete), stone, Ferroconcrete, etc.

The tanks could be built above ground, partially underground, or entirely underground, depending on the availability of space on land. To ensure the quality of water stored in the holder, several maintenance steps including purification and cleaning are required. The buildings described below are utilised in part if the collected water is used to power the subterranean aquifer/store [96].

Rejuvenate: Rainwater collected in sensible structures (such as dug wells, bore wells, charged trenches, and pits) can replenish groundwater supplies [97]. There are a variety of possible energised structures, some of which facilitate shallower water percolation through soil layers (e.g., revive trenches, penetrable asphalts) [98]. However, the groundwater is joined by others, which carry the water to greater depths (e.g. revive wells) [99]. In many cases, it is not necessary to construct brand-new buildings because old ones can simply be renovated, such as wells, pits, and tanks. Some of the more common revitalization methods include: recharging administration tube wells; reviving burrowed wells and abandoned tube wells; revitalising settlement tanks; revitalising recharge pits; revitalising soak ways/percolation pits; revitalising recharge troughs and trenches; revitalising modified infusion wells; and revitalising recharge pits and troughs (fig.3).

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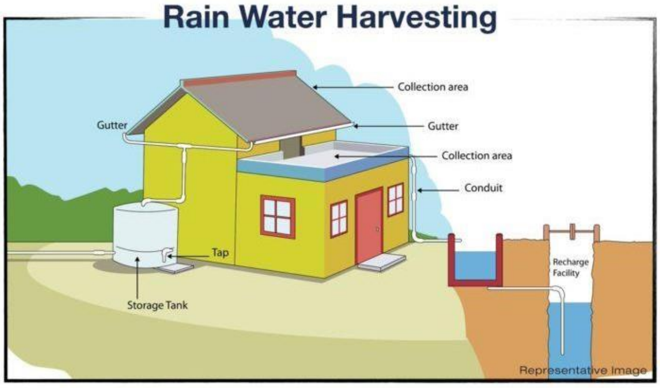

Figure 3: Components of rainwater harvesting system [11]

Rain Water Harvesting Techniques [1]

There are two fundamental procedures for rainwater harvesting:

- Storage of water on the surface for some time later
- Revive to groundwater

Underground storage tanks, lakes, check dams, weirs, and other structures were commonly used to collect rainfall at the surface. Another method of gathering rainfall, known as "energise to groundwater," typically employs the following structures:

Pits The shallow aquifer is revitalised through the construction of recharge pits. These range in size from 1 to 3 metres in depth and have stone, rock, and coarse sand inlays.

Trenches are constructed at shallow depths where penetrable strata can be reached. Depending on the availability of water, the trench could be 0.5 to 1 m in width, 1 to 1.5 m in depth, and 10 to 20 m in length. The channel is used to restock them. Materials.

Water should be filtered through channel media before being poured into an existing dug well, which might be used as a revitalization structure.

If water is scarce, shallow and deep aquifers could be revitalised with the help of existing hand pumps. In order to properly supply hand pumps, water must first pass through channel media.

Revive Shafts: These are dug to a depth of 10 to 15 metres, with a diameter of 0.5 to 3 metres, in order to replenish the shallow aquifer that is just below the clayey surface.

Lateral shafts with bore wells: to energise the higher and deeper aquifers, lateral shafts of 1.5 to 2 m. broad and 10 to 30 m. long, depending on the availability of water, with perhaps a few of bore wells being created. Stones, boulders, and coarse sand line the slanted shafts. This tactic is used when the first layer of permeable stratum is at the top. Check dams, nala bunds, bond plugs, gabion structures, and permeation lakes can be constructed to distribute water in streams and nalas.

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Components of Consideration

In most cases, a framework has a limited catchment area and carrying capacity. The climatic range is quite remarkable. A prolonged drought could cause the capacity tank to run low. Customers may experience difficulties with the upkeep of water gathering systems and the quality of the water collected. The cost of open water systems may go down if water harvesting infrastructure is vastly improved. It is important to have clear standards for clients/engineers to follow while constructing rainwater collecting frameworks, which are often not a part of the construction code. The general public has not considered collecting and using rainwater as part of the infrastructure for providing water. Water consumption is typically not included in government water administration procedures, and residents rarely volunteer to use water in communal settings. Children who are playing near large tanks used to store rainwater could be in danger. Potential profit space could be eaten up by rainwater storage tanks. Larger water catchment systems may have prohibitively large upgrading costs if those costs are not shared between other systems as part of a multi-purpose setup. After considering these benefits and drawbacks, national/client gatherings and government water authorities could deliberate using water as an alternative water supply.

Data Collection and Results

Analyzing weather reports and NASA's climate survey from 2001 to 2020 yields an annual average rainfall of 1068.39 mm for the campus region.

Catchment Area

Rainfall that falls from above is caught by the catchment area, which is the roof. The study chooses as catchment areas the rooftops of three buildings: the main building, the new boys' dormitory, and the new building. Table 3 lists the selected buildings along with their heights and total roof areas.

Table 3: Area and Height of the buildings

S.No.	Building Name	Roof Area (m^2)	Height (m)
01	Main Building (Block-A)	2202	16
02	Main Building (Block-B)	2588	12
03	Masjid Building	944	8
04	Hostel Building (Block - A&B)	1091	12
05	Hostel Building (Block - C&D)	927	12
06	Laboratory Building (Block – I & II)	594	4

Calculating how much water can be collected from rain in a given area is called estimating a region's rainwater potential. The potential for collecting rainwater is a measure of how much can be collected efficiently. The potential for collecting rainwater can be determined by applying the following equation (fig.4).

Figure 4: Construction of discharge

The runoff coefficient value used in this research was derived from the handbook of artificial recharging of groundwater published by the Government of India Ministry of Water Resource Central Ground Water Board.

Using the recommendations, we were able to estimate the yearly rainwater collecting potential of the six catchment sites, including the two major structures, the masjid building, the hostel blocks, and the laboratory buildings. Runoff coefficient was calculated to be 0.95 based on data in Table 4. It was found that 2626.522 m3 of rainwater could be collected from the roof of the main building (block - B). Table 4 is a summary of various catchment areas' possibilities for rainwater harvesting.

Table 4: Rainwater harvesting potential of the total catchment

Building Name	k	I (m)	A (m^2)	Volume (m^3)
Main Building (Block - A)	0.95	1.0683	2202	2234.776
Main Building (Block - B)	0.95	1.0683	2588	2626.522
Masjid Building	0.95	1.0683	944	958.051
Hostel Building (Block – A&B	0.95	1.0683	1091	1107.239
Hostel Building (Block – C&D	0.95	1.0683	927	940.798
Laboratory Building (Block - A)	0.95	1.0683	594	602.841
Total Volume				8470.227

The College's total water demand was calculated using the per-person home water consumption rates specified by the Central Public Health and Environmental Engineering Organization in Table 5.

Table 5: Estimation of water demand

Activities	Litres/person
Drinking Purpose	03
Cooking Purpose	04
Bathing and Flushing Purpose	60
Washing clothes Purpose	25
Washing Utensils Purpose	20
Gardening Purpose	23
Total demand (litres/person/day)	135

The College's Admin and HR departments' demographic data was used to calculate an estimate of the campus's overall water demand, taking into account the needs of various users on a daily basis. The data obtained in this regard are detailed below [2].

Total number of students on campus	:	1328
Number of students in a hostel	:	426
Several security guards	:	22
Several teaching staff	:	118
Several Non-teaching staff	:	53
Several staff staying within campus	:	09
The total number of day scholars	:	902

Total water demand = Total demand of water needed litres/person/day * Population

= 135 litres/person/day * 1521 / 1000

= 205.335 m^3 /day.

For the purpose of estimating the total water consumption by various users and taking their daily requirements into account as per the rules, demographic data of the campus was acquired from the College Admin and HR departments. Below, we detail the data we were able to acquire in this regard [2].

Total number of students on campus	:	1328
Number of students in a hostel	:	426
The number of security guards	:	22
Several teaching staff	:	118
Number of Non-teaching staff	:	53
Number of staff staying within campus	:	09
Total number of day scholars	:	902

Total water demand = Total demand of water needed litres/person/day * Population

= 135 litres/person/day * 1521 / 1000

= 205.335 m^3 /day.

Selection of catchment area for rooftop water harvesting structure

The total water demand by the College is 205.335 m^3 /day. Based on the above calculations, the main building (Block - A) catchment area is sufficient to compare demand and supply.

Calculation of discharge

To find out the required diameter of the pipe to be used for draining the rainwater down from the roof, first, we need to calculate the discharge Q, i.e. given by [2],

Q = CIA (1)

Where,

Q	=	discharge from roofs due to rainfall in (m3 /s)
C	=	Coefficient of runoff by rational method taken as 0.8 for this case
I	=	Intensity of rainfall, i.e.20 mm/hr.
A	=	Area of a catchment, m2

Discharge from different catchment areas was estimated to calculate the required diameter of rainwater harvesting pipes and summarised in Table 6.

Table 6: Total discharge of the catchment

Building Name	Constant (C)	I (mm/hr)	A (m2)	Q (m2/sec)
Main Building (Block - A)	0.8	20/3600000	2202	0.009786
Main Building (Block - B)	0.8	20/3600000	2588	0.011502
Masjid Building	0.8	20/3600000	944	0.000419
Hostel Building (Block – A&B	0.8	20/3600000	1091	0.000484
Hostel Building (Block – C&D	0.8	20/3600000	927	0.000412
Laboratory Building (Block - A)	0.8	20/3600000	594	0.000264
Total Discharge				0.022867

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Using the above formula, the total number of required RWP was calculated and summarised in Table 7.

Table 7: Total no of Rain Water Pipes

Building Name	d (m)	V (m/sec)	Q (m3/sec)	Number of pipes
Main Building (Block – A)	0.1	0.1	0.009786	13
Main Building (Block – B)	0.1	0.1	0.011502	15
Masjid Building	0.1	0.1	0.000419	01
Hostel Building (Block – A&B)	0.1	0.1	0.000484	01
Hostel Building (Block – C&D)	0.1	0.1	0.000412	01
Laboratory Building (Block – A)	0.1	0.1	0.000264	01
Total no. of Pipes				32

Time of Concentration

In this study, the rooftop area and the length of the drain were considered for the calculation of the time of Concentration (table 8).

$T_C = 0.0195\, L^{0.77}\, S^{-0.385}$

Where,

Tc = time of concentration, minutes

L = overland flow length, m

S = average slope of the overland area.

Table 8: Time of concentrations for the catchments

Building Name	L (m)	S (Slope)	Tc (Minutes)	Tc (Hours)
Main Building (Block – A)	84	0.05	3.7600	0.00626
Main Building (Block – B)	126	0.05	3.9766	0.066002
Masjid Building	56	0.05	3.6014	0.06002
Hostel Building (Block – A&B	86	0.05	3.7708	0.06284
Hostel Building (Block – C&D	86	0.05	3.7088	0.06284
Laboratory Building (Block – A)	48	0.05	3.5530	0.05921

The volume of the Recharge Well considering the main building as the catchment area. There are 10 pits with a 5.3 m3 volume over the entire campus region (fig.5).

Figure 5: Vertical discharge pipe and discharge

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Design of the Filters

Three types of filters are available to be used in recharge structures,

Gravity Filters

The majority of people use these filters. These filters consist of three stacked layers of 2-4 mm coarse sand/fine gravel, 5-10 mm gravel, and 5-20 cm boulders. The top layer should be made of coarse sand or pea gravel, allowing the silt content brought by runoff to settle on top for easy removal. Broken bricks can fill the pit if the roof is too small. Maintaining a constant recharge rate via the filter material requires scraping the top 5-10 centimetres of sand or pea gravel once a year. Depending on the silt load of the stormwater, the thickness of these layers might range from 0.3 m to 0.50 m. The filtration rate is 200 l/h/m2.

On-Line Filters (Dewas' Filters)

The PVC filter is between 1 and 2 metres in length. It should be 15 cm in diameter if the roof is less than 150 sq m, and 20 cm if it's greater than that. On both ends of the filter is a 6.25-centimeter reduction. PVC screens separate the filter into three sections to prevent cross-contamination. Gravel (6-10 mm) fills the first chamber, pebbles (12-20 mm) fill the second, and larger pebbles fill the third (20-40 mm).

Pressure Filters

Sand is used in these filters, and water is forced through it at high pressure. Pumps are built into these filters to force water through the filtration system. Energy is needed to run these filters, and they need to be back-washed occasionally to get rid of the finer material and keep the filtration rate constant. Rate of filtration is three thousand to five thousand litres per square metre per hour. To begin, we have totaled the aforementioned works systematically (table 9):

Table 9: Total length of discharge pipes

Building Name	Distance covered by Discharge pipe till recharge well (m)
Main Building (Block - A)	120
Main Building (Block - B)	97
Masjid Building	32
Hostel Building (Block – A&B)	64
Hostel Building (Block – C&D)	64
Laboratory Building (Block - A)	33
The total length of the Recharge pipe	410

Conclusion

The purpose of this research was to create a plan for installing a rainwater harvesting system on the roof of the Dhaanish Ahmed College of Engineering. This will alleviate water scarcity by aiding in the artificial recharging of groundwater. Based on the water demand and supply on campus, the main building was chosen as the catchment area for rainwater gathering. In addition, the RWH system's many components were developed using industry standards. Based on the findings, it was determined that the Dhaanish Ahmed College of Engineering, Chennai campus could store a total of 58,427.43 m3 of water throughout the year, eliminating water shortages during the dry months when the monsoons don't arrive. This plan can improve the quality of both surface and groundwater by increasing the availability of water for construction and gardening and aiding in the artificial recharge of groundwater.

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