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# Implementation of sustainable water management techniques to conserve water in an office building: A case of Noida

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*Abstract :* Water is a necessary component for life to exist. It represents economic, social, and cultural significance as a biological ingredient of living beings and as a sustainer of life flora and fauna. The old belief that water was a limitless resource with infinite regenerative capacity is no longer valid. The increase in population, along with a constant increase in polluting activities, has resulted in an increase in catastrophic circumstances around the world connected to the shortage of this priceless resource, either in terms of quantity or quality, to meet mankind's vital needs.
We have a huge issue in managing and protecting our important water resources as the world's population continues to grow and our cities and suburbs expand with more buildings to accommodate the growth.
As clean freshwater resources become scarce, it is increasingly evident that wastewater and storm water should be considered as alternative and useful sources of water, rather than as nuisances to be dealt with. As a result, rainwater collection and reuse, as well as the reuse of highly treated wastewater effluent, are gaining popularity.

***IndexTerms* – Water, conservation, management, consumption, resource, harvesting**

## I. Introduction

Water covers 71.7 percent of the Earth's surface, however only 3% of that water can be used as drinking water. Water conservation has become a big issue in recent years as the world's population has grown rapidly. Sustainability is being practiced all around the world to limit resource use, lessen detrimental effects on the environment, and promote a clean environment. With the rising demand for water, it is becoming increasingly important to incorporate water conservation into the design of green or sustainable structures.

Water conservation refers to the policies, tactics, and activities that are used to manage fresh water as a long-term resource in order to conserve the environment while also meeting present and future human needs. The amount of water consumed is influenced by population, household size and growth, and prosperity. Climate change, for example, will put more strain on natural water resources, particularly in industries and agricultural irrigation.

The following are some of the objectives of water conservation efforts:

- **Sustainability:** The depletion of fresh water from an ecosystem should not exceed its natural replenishment rate in order to preserve its availability for future generations.
- **Energy conservation:** Water pumping, distribution, and waste water treatment facilities use a lot of energy. Water management consumes more than 15% of total electricity usage in various parts of the world.
- **Habitat conservation:** Lowering human water use helps to protect freshwater habitats for local wildlife and migrating waterfowl while also reducing the demand for new dams and other water diversion infrastructure.

Water is a necessary component for life to exist. It represents economic, social, and cultural significance as a biological ingredient of living beings and as a sustainer of life flora and fauna. The old belief that water was a limitless resource with infinite regenerative capacity is no longer valid. The increase in population, along with a constant increase in polluting activities, has resulted in an increase in catastrophic circumstances around the world connected to the shortage of this priceless resource, either in terms of quantity or quality, to meet mankind's vital needs.We have a huge issue in managing and protecting our important water resources as the world's population continues to grow and our cities and suburbs expand with more buildings to accommodate the growth.As clean freshwater resources become scarce, it is increasingly evident that wastewater and storm water should be considered as alternative and useful sources of water, rather than as nuisances to be dealt with. As a result, rainwater collection and reuse, as well as the reuse of highly treated wastewater effluent, are gaining popularity.

## CONSERVATION

Water that has been recycled might be considered a renewable supply of water. The restricted supply of usable water within the hydrologic cycle, on the other hand, imparts both an economic and an intrinsic value on this limited resource, implicitly recommending that it be used more than once before being returned to the hydrologic cycle.

As the demand for water continues to rise, water reuse is becoming an increasingly vital part of the planning, development, and overall use of water resources in both desert and humid climates. When compared to the ever-increasing costs of developing fresh supply, efforts to reduce water pollution have resulted in treated water effluent, which represents a significant and economical source of supply sources. Wastewater can be used for non-potable purposes in agriculture or for industrial cooling, and it has the potential to be a viable alternative to treated and potable water. The integrated management of potable resources and wastewaters, as well as their reuse, should allow for flexibility in meeting short-term demand while also ensuring long-term supply. Droughts have little effect on urban wastewaters, therefore recycling provides a reliable source of water during dry periods.

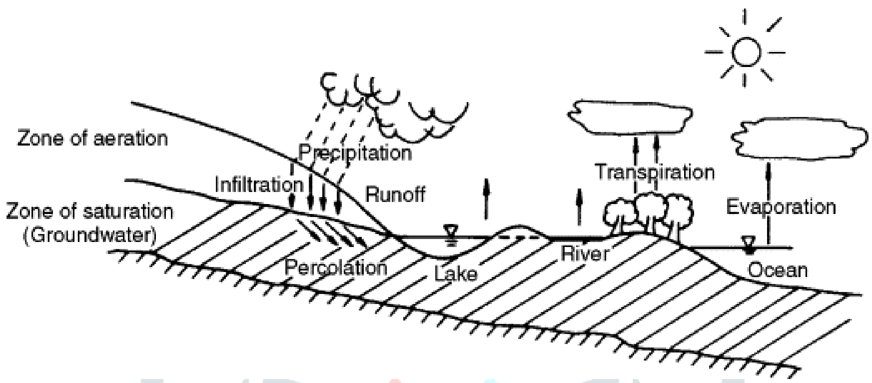



*Figure 1 Water cycle*

Without a reliable water supply, no country can be economically or socially stable. The numerous methods for conserving, recycling, and reusing water, when combined, form the basis for an efficiency revolution. Massive water availability for agriculture, industry, and cities is now conceivable because to easily available techniques and technologies. However, due of policies and laws that favour waste and misuse rather than efficiency and conservation, society is still on the verge of transition.

Moving toward more efficient, environmentally sound, and long-term water usage patterns necessitates significant changes in the way water is priced, allocated, and managed. Appropriate pricing, the formation of markets for buying and selling water, and other economic incentives for water use are all aims that should be sought by all countries, especially those with water scarcity. Recycling and reuse technologies are promoted by the following organisations and institutions: ·

State of California, California Municipal Wastewater Reclamation, California State Water Resources Control Board, Office of Water Recycling, Sacramento, CA, USA.

- Dames & Moore, Water Pollution Control Engineering Services, EPA 430/9- 77-013, Office of Water Program Operations, US Environmental Protection Agency, Washington, DC, USA.
- World Health Organization, Geneva, Switzerland.
- American Water Works Association Research Foundation, Denver, CO, USA.

Since the utilization of construction water directly varies with the kind of construction, a steel and glass building can have its embodied water-footprint chiefly on account of that of its materials whereas on-the-spot water use plays a serious role just in case of a cast-in-situ strengthened cement concrete and brick building. Thus, water potency at the assembly stage is needed within the initial case whereas the second class demands considerations and actions at the consumption stage. This paper examines a number of the problems associated with the topic like water demand at material production further as construction stage and also the resultant embodied water of typical urban constructions in Asian nation, that was found to be within the vary of concerning twenty seven Kiloliters/Sq m of total settled space.

**Aim:**

To suggest water conservation techniques for an existing commercial office building and calculate its reduction in water consumption after application of sustainable water management techniques.

**Objectives:**

- To analyze the present condition of water distribution system of selected building.
- To analyze the present water management technique.
- To compare the existing water techniques in the selected building with the suataible water techniques that can be implemented.
- To suggest and recommend measure for retrofitting of existing techniques or adaptation
  Of new techniques.

**Scope:**

The scope of the study is to optimize operational and maintenance costs in a govt. office building by implementing sustainable water management techniques and to compare the differences with conventional costs of the same.

**Limitations:**

The study is limited to reducing O&M costs through sustainable water techniques only and excludes other parameters of life cycle cost. Also, the study only limits to a office building in urban CBD because it will have proper water supply, drainage network and maintained records.

**Methodology:**

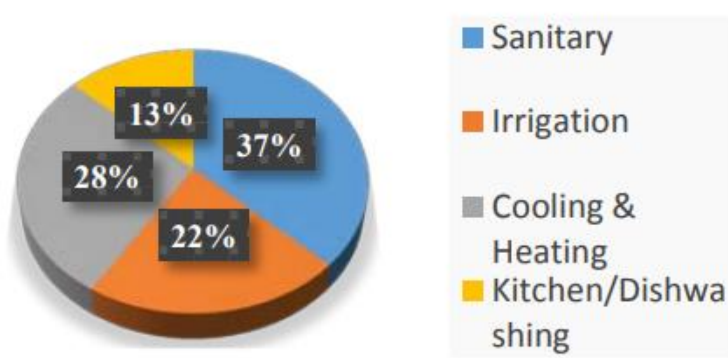
1. Collection of Background Knowledge on O&M cost of Water distribution.
2. Collection of Data based on Literature and Live case study of an Existing Govt. Building.
3. Analysis of data based on the case study and life case study and determination of parameters of study through comparative analysis of the cases.
4. Study and data interpolation based on the parameters of sustainable water resources of a building.
5. Inference based on drawback and issues.
6. Dissertation research forward towards forming brief for Thesis.

## II. LITERATURE

### Water conservation

The sources of water which may be employed by humans in their daily lives square measure restricted. With the speedy increase in population the demand for water is additionally growing. All the water resources can get exhausted and also the world in future can face water scarceness. Thus, there's a dire want for protective water and preventing its pollution. One in every of the most objectives of inexperienced buildings is to scale back water use and defend its quality. conservation throughout the entire lifetime of a building will be achieved by planning twin plumbing that recycles the water employed in water closets and also the water accustomed wash cars, exploitation water economical fittings and fixtures like ultra-low flushing bogs, bidets and low flow showerheads. Alternative technologies like rain water harvest and use and reprocess of greywater, etc. also are being employed.

With the quick development of the world economy, depletion of water resources is changing into Associate in nursing environmental issue of the utmost concern worldwide. The global organization World development Report (WWDR) indicates that water for all our uses is changing into scarce and is resulting in a water crisis. The results a sector will wear the setting area unit obscurity additional apparent than within the building business. Building construction and its operations draw heavily on water from the setting.
Growth in urban water use has caused a big reduction of water tables and necessitating massive comes that siphon provides aloof from agriculture Water accustomed operate buildings could be a major factor of national water



consumption. However, this can be not the sole kind of water consumed throughout a building's life cycle. Water is additionally consumed within the extraction, production, producing, and delivery of materials and merchandise to web site, and also the actual on-the-scene construction method "embodied" water.

*Figure 2 Every Drop Counts...!*

*Figure 3 Water is a life essential resource.*

Water potency refers to the decrease within the usage of water yet as decrease within the wastage of water. Wastage of water or its additional usage results in drawing out of a lot of water from the H2O resources, leading to their depletion. Thus, water economical technologies are developed to conserve potable yet as non-potable water and to ultimately save the already restricted H2O resources. Water economical technologies in buildings in the main embody water saving fittings and fixtures. They additionally embody rain water gathering and use and reprocess of gray water.

Water conservation will be outlined as:

- Any helpful deduction in water loss, use, or waste.
- A reduction in water use accomplished by implementation of conservation or water potency measures; or,
- Improved water management practices that scale back or enhance the helpful use of water a conservation live is AN action, behavioural modification, device, technology, or improved style or method enforced to cut back water loss, waste, or use. Water potency may be a tool of conservation. That ends up in a lot of economical water use and therefore reduces water demand. the worth price|and price|and value}-effectiveness of a water potency live should be evaluated in relevancy its effects on the utilization and cost of different natural resources.(e.g. energy or chemicals)

The goals of conservation efforts include:

- Sustainability- to confirm convenience for future generations, the withdrawal of H2O from AN system mustn't exceed its natural replacement rate.
- Energy conservation- Water pumping, delivery, and sewer water treatment facilities consume a big quantity of energy. In some regions (e.g. California2) of the globe over V-J Day of total electricity consumption is dedicated to water management.
- Habitat conservation- Minimizing human water use helps to preserve H2O habitats for native life and migrating water bird, yet as reducing the necessity to make new dams and different water diversion infrastructure.

Water conservation in buildings is one in all the simplest ways in which to save lots of water and scale back your building's water use. Installation of low-flow fixtures, showerheads, and bathrooms, for instance, will create an enormous impact. The American state Building business Association offers the subsequent tips for putting in and maintaining low-flow fixtures:

There are a number of strategies that can be employed to reduce the amount of water consumed at a facility. In general terms, these methods include:

- System optimization (i.e., efficient water systems design, leak detection, and repair);
- Water conservation measures; and
- Water reuse/recycling systems.

**Rainwater harvesting system**

Because of water crises phenomena, in some rural countries, drinking clean water has become a luxury. Nowadays, potable water may be a depleting resource. Potable water isn't continually on the market and in several cases it's solely doable with high initial and maintenance price that makes it not possible to implement. fresh water may be a renewable supply and comparatively drinkable once a correct treatment. fresh water harvest saves high-quality potable water sources and it's an appropriate answer for decreasing the high sewerage level, mitigating floods, and soil erosions.

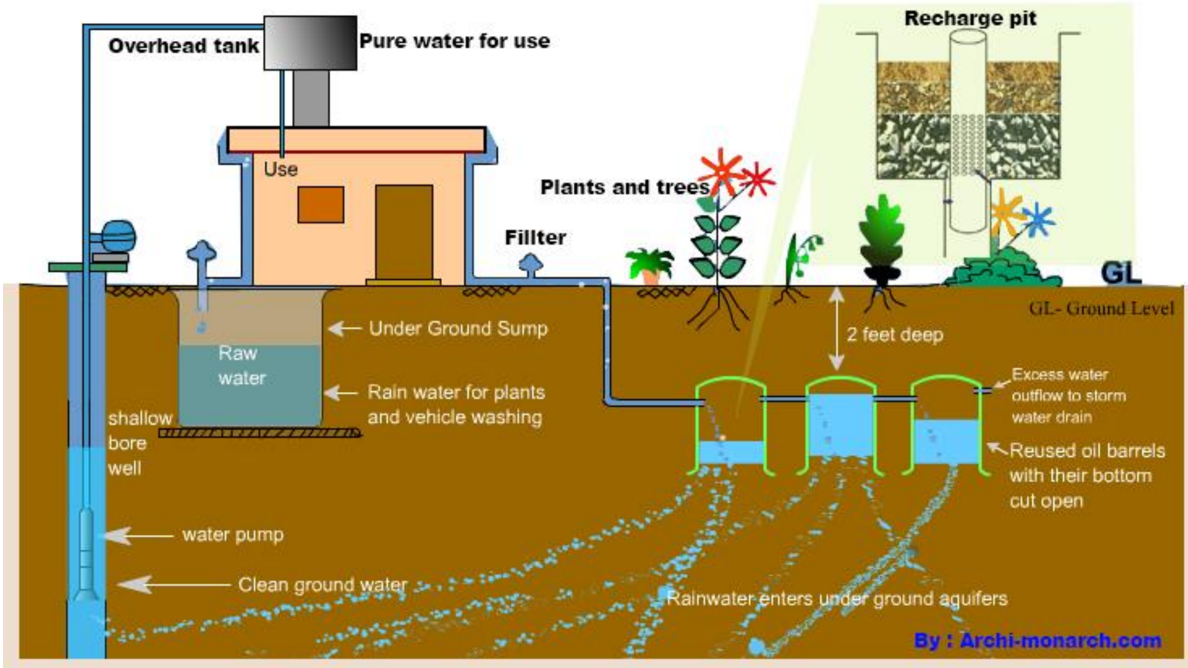



*Figure 4 Rain water harvesting schematic diagram*

**Stages in Rainwater Harvesting**

A basic system for the harvesting of rainwater consists of three stages:

- **Collection Stage**

Rainwater gathering begins with this step. Rainwater is collected in a container on rooftops, pavement, or the soil surface while it is raining in a catchment region. Rainwater is collected and transported to a storage tank by channels that run all the way around the edge of a sloping roof.

- **Distribution Stage**

Pipelines form the foundation of RWH's distribution system. They transport rainwater to the harvesting system from the catchment or rooftop area. They are built of galvanized iron sheet (20 to 22 gauge), PVC, and bamboo and can be semi-circular or rectangular.

- **Storage Stage**

Following collecting and distribution, the most crucial step is the storage system. A storage tank is used for simple RWH. The storage tank's capacity is determined by a number of design criteria:

- rainfall
- the length of dry season
- estimated need

The growing demand for water is causing the ground water table to drop. Rainwater replenishes the groundwater table. This water is available in lakes, rivers, ponds, aquifers, etc. but these are fickle sources. Treated rainwater can solve the demand of household water needs. Water sources are typically located far from the community. The cost of distribution will be reduced if rainwater can be collected and used.

**Greywater recycling**

Greywater is defined as wastewater generated by wash basins, showers, and baths that can be recycled on-site and used for toilet flushing, landscape irrigation, and other non-potable purposes. Due to the high nutrient levels, greywater does not include wastewater discharge from washing machines, dishwashers, or kitchen sinks. Bathroom waste is classified as wastewater contaminated with faeces.

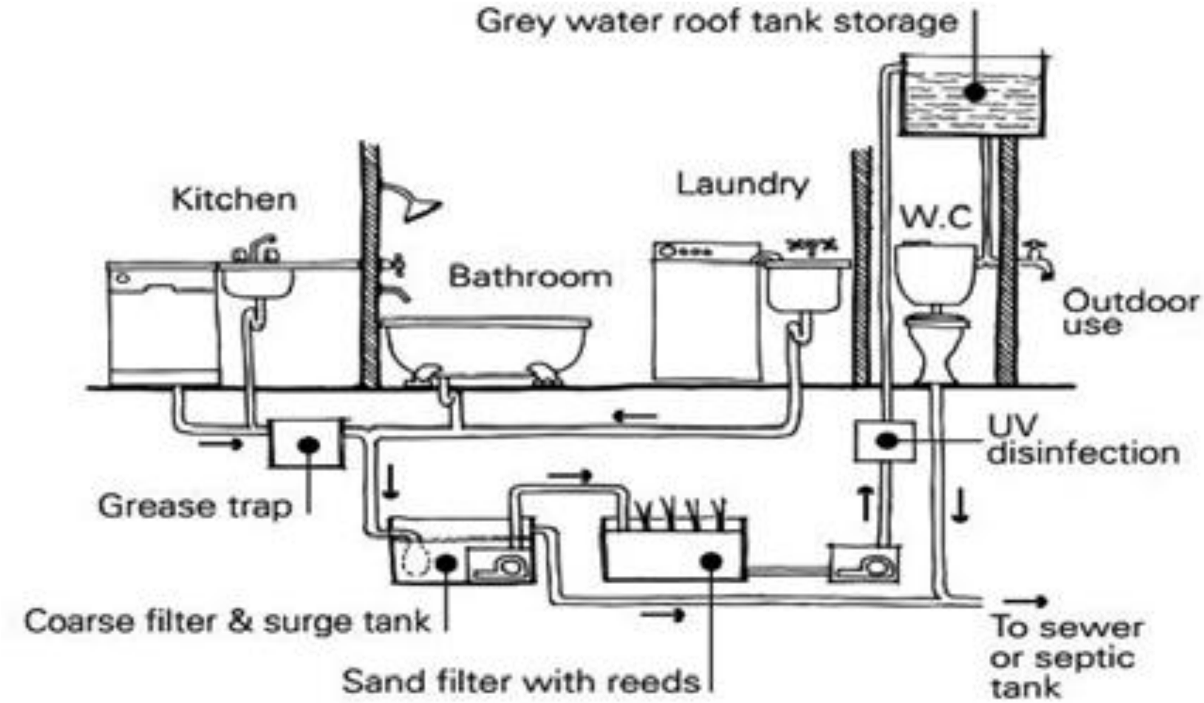



*Figure 5 Grey Water Treatment and Recycling Technique*

The amount and quality of greywater will influence how it is reused in part. Irrigation and toilet flushing are two examples of typical use. Irrigating lawns, trees, ornamentals, and food crops with greywater is a viable option. Though greenhouse irrigation systems differ significantly from outdoor watering, there are certain greywater standards that apply to both circumstances. Because toilet flushing accounts for up to 50% of indoor water use, it can use a significant quantity of greywater. When low-quality greywater is used for toilet flushing, it is not a problem because the water is disposed of in the sewer or septic system. The following are the components of a greywater recycling system: greywater collection, conveyance, treatment, storage, and reuse of recycled greywater. Greywater recycling has the advantage of reusing the water that is wasted in daily life, which accounts for about 40% of a person's daily water usage. One of the most serious worries about greywater recycling is the possibility of a health problem due to insufficient disinfection procedures.

**High Water Efficiency Fixtures**

In order for good sustainable designs to be realised, efficient facilities are required. The importance of using water efficient flush and flow fixtures to improve water sustainability primarily embodies the following four aspects: reducing the volume of water consumed per flush or per unit time without sacrificing performance, improving water efficiency, reducing water waste caused by unnecessary leakage, and reducing water use helps reduce energy consumption in water supply and drainage. To determine whether a fixture is water efficient, we must compare its water usage to a baseline, often known as the standard value. The installation of these facilities lowers the cost of water supply.

*Figure 6 Dual flush urinal and WC*

**Water wise landscaping**

Water-wise landscaping refers to high-quality landscaping that conserves water and is environmentally friendly. Planning and design, soil preparation, sensible plant selection, feasible grass areas, effective irrigation, and other basic principles underpin water-friendly landscaping. This type of landscaping results in a lush, beautiful landscape while saving time, money, and energy, as well as preventing water pollution and waste.

Landscaping water usage can easily account for 20% or more of facility water consumption, and is a key area to target for water use savings. There are three major components to designing a water-efficient landscape for a new facility:

- reduce the amount of turf and other irrigated areas
- ensure water-efficient design of irrigation systems, and
- specify native or climate appropriate landscape materials (Xeriscape).

Reducing the amount of turf grass and overall irrigated areas reduces water usage and associated costs, as well as mowing, fertilising, waste removal, and maintenance time and money. Water-efficient irrigation systems (low-flow sprinkler heads, efficient system design and layout, and optimised irrigation schedules and controls) should be used in the remaining landscape areas that require irrigation to minimise water use and maximise plant health. When possible, use Xeriscape tactics to save money on water, fertiliser, pruning, upkeep, labour, and overall costs.

Xeriscape is the use of native or climate-appropriate plants that are adapted to the local environment, require less water, are more likely to withstand droughts, and are pest and disease resistant. A comprehensive Xeriscape approach analyses the growth patterns, maintenance requirements, and interactions of climate-appropriate plants with local climate and soil conditions.The different techniques being used for conservation of water are discussed below:

**Adoption of Micro Irrigation Systems**

- **Sprinkler Irrigation System**

Sprinkler irrigation is a similar-to-rainfall way of applying irrigation water. As seen in Fig. 2, water is distributed through a system of pipes by pumping. The water is then sprayed into the air and used to irrigate the entire soil surface via spray heads, breaking up into small water drops that fall to the ground. Sprinklers are appropriate for use on all sorts of irrigable soils and provide efficient coverage for small to large areas. More land is available for cultivation as a result of the adoption of this approach, and water is more efficiently used.

- **Drip Irrigation System**

The most efficient technique of irrigation is drip irrigation. While sprinkler systems are typically 75-85% efficient, drip systems are often 90% or higher. Drip irrigation uses a dripper/emitter to provide water gently and directly to the soil, as seen in Figure 3. Drip irrigation's great efficiency is due to two key considerations. The first is that before it can evaporate or run off, the water soaks into the soil. The second difference is that instead of being sprayed everywhere, the water is exclusively applied where it is needed (at the plant's roots).

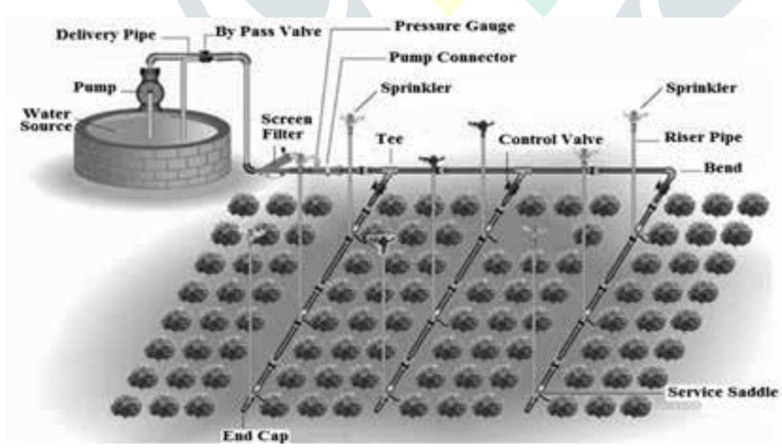



*Figure 7 Layout of Sprinkler Irrigation System*

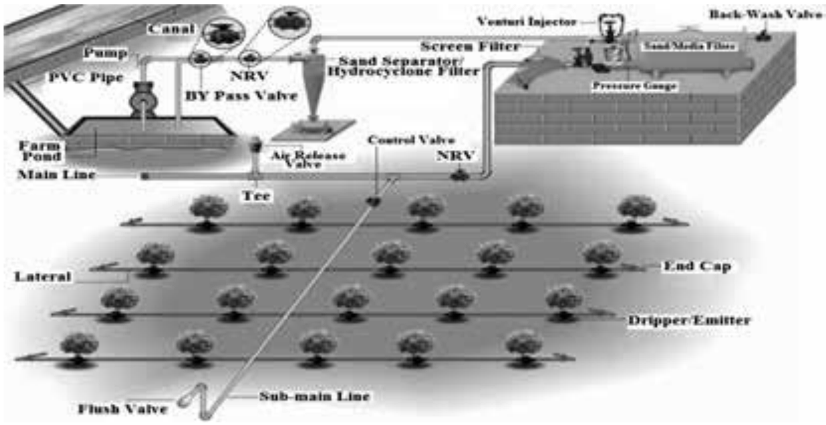



*Figure 8 Layout of drip Irrigation System*

**Cooling Towers**

Evaporative cooling systems are used in green buildings to save energy. Water is used to cool these systems. Because of the necessity for water conservation, the water used in these cooling systems is non-potable. The circulating water is reused in cooling towers rather than being drained. It is advised that cooling towers be used, as they recycle nearly 95% of the entire water.

**Inferences of Literature Studies:**

Table 1: Literature inferences

| S. NO. | TITLE | AUTHOR | YEAR | OBJECTIVE | ANALYSIS CRITERIA | METHODO-LOGY | INFERENCES |
|---|---|---|---|---|---|---|---|
| 1 | Design of A Sustainable Building: A Conceptual Framework for Implementing Sustainability in the Building Sector | Peter O. Akadiri , Ezekiel A. Chinyio and Paul O. Olomolaiye | 2012 | This paper presents a conceptual framework aimed at implementing sustainability principles in the building industry. | | Literature based | The challenge for designers is to find new ways to combine these many sustainability needs. Every design option must be considered in terms of its influence on the natural and cultural resources of the local, regional, and global contexts in the new design approach. |
| 2 | Assessment of water resource consumption in building construction in India | S. Bardhan | 2011 | This paper examines some of the issues related to the subject like water demand at material production as well as construction stage. | ground water, site water management. | Literature based | ThisThe paper looks at some of the challenges surrounding the subject, such as water consumption during material manufacture and construction, as well as the embodied energy that results. water in typical Indian urban structures, which was discovered to be in the range of approximately 27 kilolitres per square metre of total built-up area |
| 3 | Smart and Sustainable Techniques for Water Conservation and Management | Narender Singh | | The goal of this study is to detail the limitations of current water management while also identifying wiser and more sustainable water conservation and management options. | | Literature based | It is necessary to save and manage available water in a sustainable and wise manner. Reduce, reuse, and recycle is a notion thatWater recycling will undoubtedly aid in the resolution of the problem.On the planet, there is a problem of water scarcity. |
| 4 | IGBC Green Existing Building O&M rating system | | | It promotes the use of water in a self-sustaining manner through measures such as decreasing, recycling, and reusing. Existing buildings that are greened can save 15–30% of their potable water by using this rating system. | | Literature based | It describes the guidelines for a combination of sustainability measures, including water efficiency and management. |
| 5 | Green Building Handbook for South Africa | Dr. Jeremy Gibberd | | The water systems utilised in green buildings are described in this chapter, along with some possible goals. It also lays out basic calculations for designing water systems in green buildings. | | LITERATURE BASED | Its aim is to create systems that reduce resource usage and pollution. Rainwater harvesting, plumbing, and ecological sanitation systems are developed with care, allowing buildings to be self-sufficient in their water needs and avoid polluting water. This minimises the need for energy-intensive and potentially wasteful large-scale water and sanitation infrastructure. |

## III. Case Development

### Candor Techspace Tower 3 & 4 :

*Figure 9 Case Development Project Location*

PROJECT LOCATION:
Noida is quickly establishing itself as a popular location for IT/ITES companies. Candor's campus, which is located in the IT/ITES SEZ in Sector 135 of this growing city, has access to the Noida-Greater Noida Expressway and is close to the DND Flyway (situated just 15 minutes away).

*Figure 11 candor tech space*

*Figure 10 candor tower 3 and 4*

Table 2: Break-up of Consumption of Domestic & Flushing Water Requirement as per NBC:

| S. No. | Description | Population As per NBC-2016, Part-9, Section-1, clause 4.1 | Water Requirement (Ltrs) | | |
|---|---|---|---|---|---|
| | | | Domestic | Flushing | Total |
| 1. | Office Area | 10 sqm / Person | | | |
| a. | Staff | | 25 | 20 | 45 |
| b. | Visitors | | 5 | 10 | 15 |
| 2 | Food Court | 1.2 sqm / Person | 25 | 10 | 35 |

Table 3: Break-up of Consumption of Domestic & Flushing Water Requirement of office:

| S. No. | Description | Occupancy | Domestic Water Req | Flushing Water Req. | Gross Water Req. | Water Flow to STP |
|---|---|---|---|---|---|---|
| | | | LPD | LPD | LPD | LPD |
| 1 | **Office Area** | 2020 | | | | |
| a | Office Staff (90% of population) | 1818 | 45450 | 36360 | 81810 | 72720 |
| b | Visitors(10% of population) | 202 | 1010 | 2020 | 3030 | 2828 |
| 2 | Auditorium & Amphti Theater | 3769 | 18845 | 37690 | 56535 | 52766 |
| 3 | Food Court | 370 | | | | |
| a | Staff @ 10% | 37 | 925 | 740 | 1665 | 1480 |
| b | Visitors @ 90% | 333 | 8325 | 3330 | 11655 | 9990 |
| 4 | Yoga, Gym etc | 1057 | 5285 | 10570 | 15855 | 14798 |
| 5 | Security & Maintenance Staff | 50 | 1250 | 1000 | 2250 | 2000 |
| 6 | Main Swimming Pool | LS | 10000 | | 10000 | |
| 7 | Filter Back wash | LS | 5000 | 0 | 5000 | - |
| | **Total** | | 96090 | 91710 | 187800 | 156582 |
| | **Say(KL)** | | **96** | **92** | **188** | **157** |

It is assumed that 80 % of domestic water and 100 % of Flushing water shall flow to sewer. Based on the number of users and for other consumption points, it is estimated that the daily water demand shall be approximately 263,000 litres per day (excluding Fire requirement) for office building. Summary of requirement is given below.

- Domestic Water Demand = 96 KLD
- Flushing Water Demand = 92 KLD
- Water for Horticulture = 5 KLD
- Cooling Tower (Soft Water Demand) = 70 KLD

**Total water requirement for office = 263 KLD**

**Through Selection Criteria:**

**Smart Water Fixture:**

The maximum flow rate and flush volumes shall be as given below as per NBC:

| PLUMBING FIXTURES/FITTINGS MAXIMUM | FLOW RATE |
|---|---|
| WATER CLOSETS | 6 litre/flush |
| URINALS | 3.8 litre/flush |
| LAVATORY, METERED FAUCET (PUBLIC) | 1 litre/use |
| LAVATORY, FAUCET (PRIVATE) | 8 litre/min |
| SINK, FAUCET | 8 litre/min |
| BIDET, HAND HELD SPRAY | 8 litre/min |
| SHOWER HEAD | 10 litr |

Currently, roughly 2020 individuals utilise water in the building on a daily basis. We estimate that over 90% of them are employees, with the remainder being visitors. Using calculation, we anticipate that the building will require roughly 263 KLD of water per day.

| FIXTURE | TOTAL NO. OF FIXTURE | NO. OF USE PER DAY (ASSUMING) | CONSUMPTION RATE (L) | WATER USES (l/DAY) |
|---|---|---|---|---|
| WATER CLOSET | 92 | 19 | 6 | 10488 |
| WASH BASIN | 73 | 50 | 8 | 29200 |
| URINAL | 27 | 121 | 3.8 | 12414.6 |
| ABLUTION TAP | 92 | 19 | 3 | 5244 |
| DRINKING | 18 | 505 | 1 | 9090 |

This includes water consumed by employees and visitors, as well as water utilised by building functions such as ventilation.

The total water consumption through traditional fixtures, as determined by the National Building Code, is approximately 66436 litres per day, or 66.4 KLD.
Reduced potable water consumption by installing efficient water fixtures and reusing STP treated water for flushing. Water efficient flow fixtures for faucets, taps, Urinals, and W.C. flush fixtures that meet with IGBC requirements are installed to reduce indoor water usage.

Table II: Maximum flow rate as per IGBC

| Fixture Type | Maximum Flow Rate/ Consumption | Duration | Estimated daily uses per person* |
|---|---|---|---|
| Water Closets | 6.0 LPF | 1 flush | 1 for male;<br>3 for females |
| Faucets / taps** | 8.0 LPM | 0.25 min | 4 |
| Urinals | 4.0 LPF | 1 flush | 2 for males |

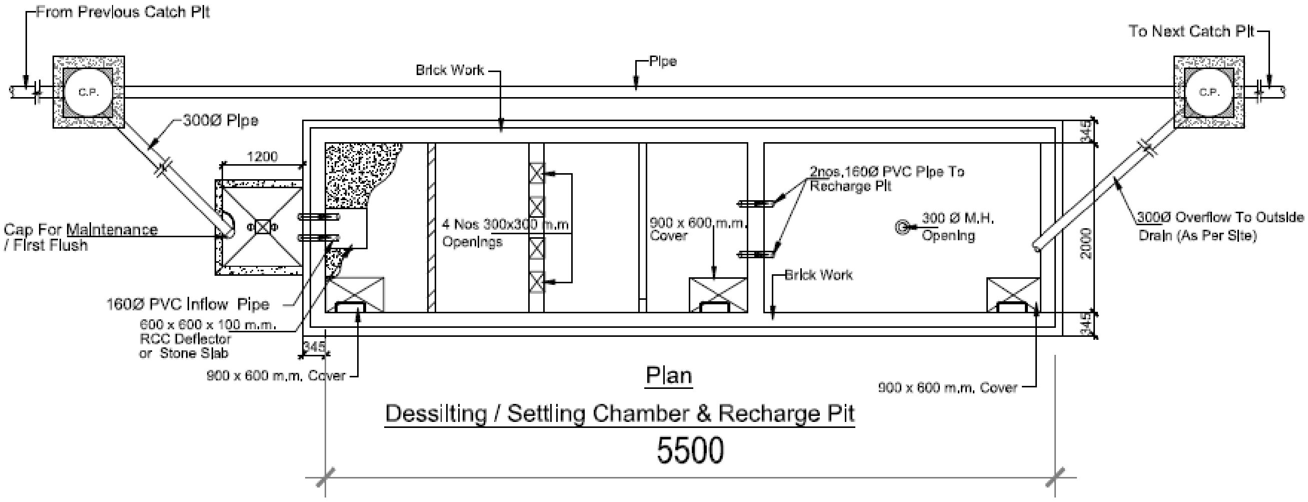
Table 5 : Water uses per day

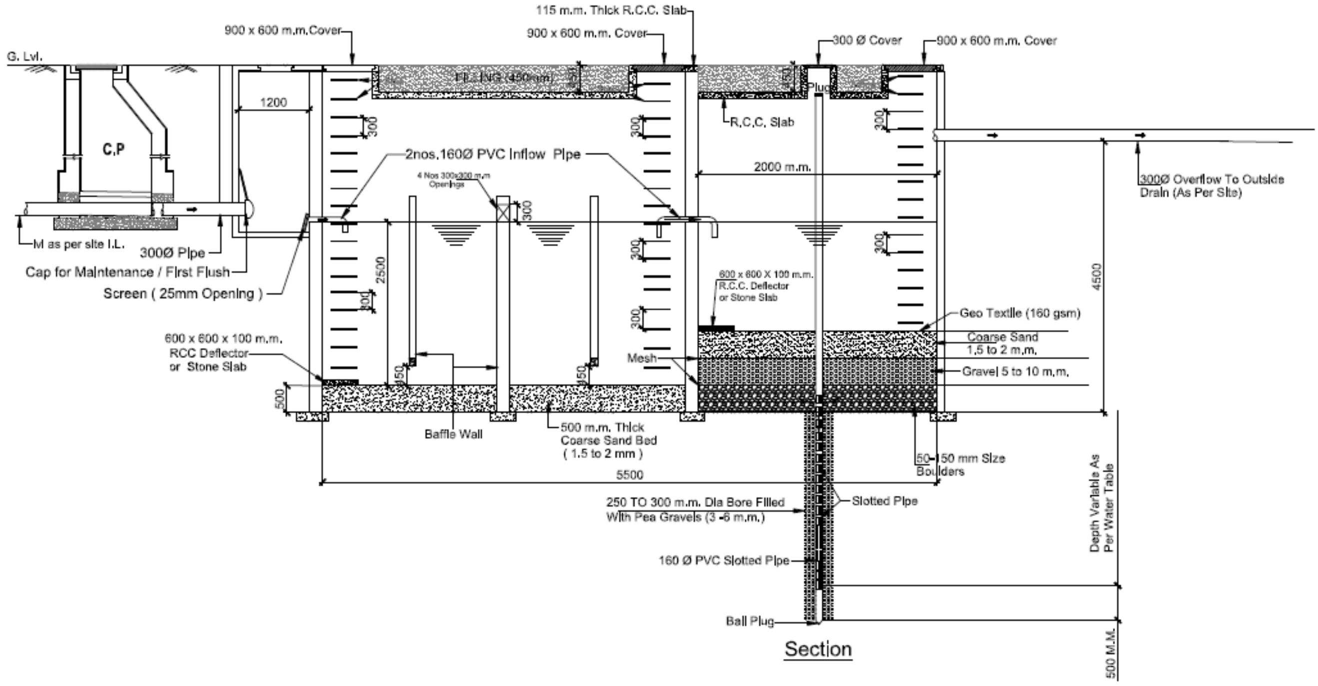
| FIXTURE | TOTAL NO. OF FIXTURE | NO. OF USE PER DAY (ASSUMING) | CONSUMPTION RATE (L) | WATER USES (l/DAY) |
|---|---|---|---|---|
| WATER CLOSET | 92 | 19 | 3.5 | 6118 |
| WASH BASIN | 73 | 50 | 2 | 7300 |
| URINAL | 27 | 121 | 0.5 | 1633.5 |
| ABLUTION TAP | 92 | 19 | 1.5 | 2622 |
| DRINKING | 18 | 505 | 1.25 | 11362.5 |

The total water consumption through smart fixtures, as determined by many companies, is approximately 29036 litres per day, or 29 KLD.
As a result, adopting smart efficient fittings in office buildings saves about 43 percent of the water used by traditional fixtures. Rain Water Harvesting
The rain water is diverted from the rooftop using rain water pipes to the drainage network. The entire Complex shall be sub divided for recharging structures.
It is proposed to provide de-silting tanks and recharge wells for the desired purpose. The rain water will be diverted into the de-silting tank to remove inorganic impurities and the outflow of the de-silting tank will be taken into the recharge well.

| | | | |
|---|---|---|---|
| **1.0** | **Areas** | | |
| | **Total Area in Acre** | = | **7** |
| **a)** | Site Area in $m^2$ | = | 29000.00 |
| **b)** | Terrace / Roof Area (approx.) | = | 7000.00 Sq.m |
| **c)** | Paved / Pavement / Road/Sub Soil Drainage (approx.) | = | 12000.00 Sq.m |
| **d)** | Green Area / Loose Area (approx.) | = | 10000.00 Sq.m |
| | | | |
| **2.0** | **Co-efficient and factors adopted (As per NBC-2016)** | | |
| **a)** | Harvesting efficiency factors for terrace and roof tops | = | 0.9 |
| **b)** | Harvesting efficiency factors for roads and paved surface/SSD | = | 0.8 |
| **c)** | Harvesting efficiency factor for Green/ soft soil | = | 0.15 |
| | | | |
| **3.0** | **Co-efficient for calculations of capacity for collection wells for Harvesting** | | |
| **a)** | Rain Fall intensity | = | 50 mm/hr |
| **b)** | Retention time for capacity of recharge tank | = | 15 min |
| **c)** | Net runoff for which holding is required for infiltration | = | 12.5 mm |
| | | | |
| **1.0** | **Roof / Terrace** | | |
| **i)** | Average runoff co-efficient for terrace | = | 0.9 |
| **ii)** | Terrace / Roof Area | = | 7000.00 Sq.m |
| **iii)** | Rain fall intensity | = | 50 mm/hr |
| **iv)** | Infiltration well capacity design period | = | 15 min |
| **v)** | Net runoff for which holding is required for infiltration | = | 12.5 mm |
| **vi)** | Required approx. theoretical volume of infiltration wells **(Total Area x Coefficient x Net Runoff)** | = | **78.75 Cu.Mtr** |

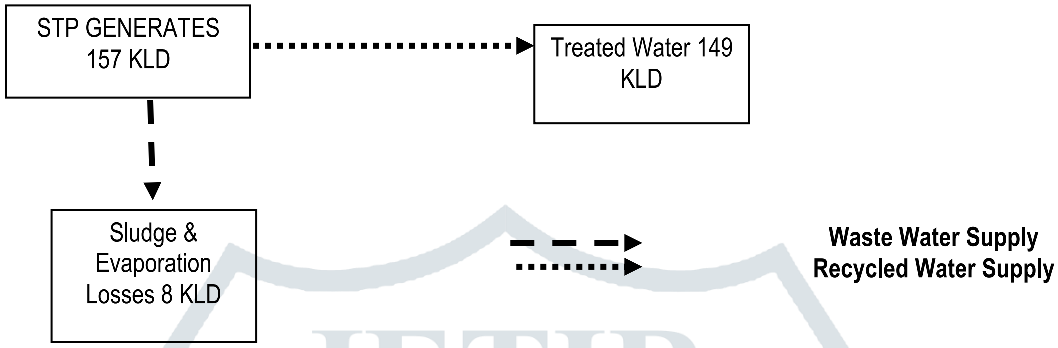
| | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| **2.0** | **Road / Paved / Pavement Area** | | | | |
| **i)** | Average runoff co-efficient for terrace | | | = | 0.8 |
| **ii)** | Road / Paved / Pavement Area | | | = | 12000.00 Sq.m |
| **iii)** | Rain fall intensity | | | = | 50 mm/hr |
| **iv)** | Infiltration well capacity design period | | | = | 15 min |
| **v)** | Net runoff for which holding is required for infiltration | | | = | 12.5 mm |
| **vi)** | Required approx. theoretical volume of infiltration wells **(Total Area x Coefficient x Net Runoff)** | | | = | **120.00 Cu.Mtr** |
| | | | | | |
| **3.0** | **Green / Loose Area** | | | | |
| **i)** | Average runoff co-efficient for terrace | | | = | 0.15 |
| **ii)** | Green / Loose Area | | | = | 10000.00 Sq.m |
| **iii)** | Rain fall intensity | | | = | 50 mm/hr |
| **iv)** | Infiltration well capacity design period | | | = | 15 min |
| **v)** | Net runoff for which holding is required for infiltration | | | = | 12.5 mm |
| **vi)** | Required approx. theoretical volume of infiltration wells **(Total Area x Coefficient x Net Runoff)** | | | = | **18.75 Cu.Mtr** |
| | | | | | |
| | **Total Volume of Infiltration** | | | = | **217.50 Cu.Mtr** |
| | Circular Pits: | | | | |
| | Dia | **Effect. Depth** | | | |
| | 3.0 M | **3.5 M** | | = | 24.73 Cu.Mtr |
| | | | | | |
| | | | **De-silting Chamber** | | |
| | Length | Width | Height | | |
| | 2.0 M | 2.0 M | 1.5 M | = | 6.00 Cu.Mtr |
| | | | | | |
| | **Total Capacity of Pair of Pit and Chamber** | | | = | **30.73 Cu.Mtr** |
| | | | | | |
| | **Total No. Pits** | | | = | **7.08 Nos.** |
| | | | | | |
| | | **Say** | | **=** | **7.0 Nos.** |
| | | | | | |


From Previous Catch Pit
To Next Catch Pit
Brick Work
Pipe
C.P.
C.P.
300Ø Pipe
1200
Cap For Maintenance / First Flush
4 Nos 300x300 m.m Openings
900 x 600 m.m. Cover
2nos.160Ø PVC Pipe To Recharge Pit
300 Ø M.H. Opening
300Ø Overflow To Outside Drain (As Per Site)
Brick Work
2000
345
345
160Ø PVC Inflow Pipe
600 x 600 x 100 m.m. RCC Deflector or Stone Slab
345
900 x 600 m.m. Cover
900 x 600 m.m. Cover
Plan
Dessilting / Settling Chamber & Recharge Pit
5500


115 m.m. Thick R.C.C. Slab
900 x 600 m.m.Cover
900 x 600 m.m. Cover
300 Ø Cover
900 x 600 m.m. Cover
G. Lvl.
FILLING (450mm)
1200
C.P
R.C.C. Slab
2nos.160Ø PVC Inflow Pipe
2000 m.m.
300Ø Overflow To Outside Drain (As Per Site)
M as per site I.L.
300Ø Pipe
Cap for Maintenance / First Flush
Screen ( 25mm Opening )
2500
600 x 600 X 100 m.m. R.C.C. Deflector or Stone Slab
4500
Geo Textile (160 gsm)
Coarse Sand 1.5 to 2 m.m.
Gravel 5 to 10 m.m.
600 x 600 x 100 m.m. RCC Deflector or Stone Slab
Mesh
500
Baffle Wall
500 m.m. Thick Coarse Sand Bed ( 1.5 to 2 mm )
5500
50-150 mm Size Boulders
250 TO 300 m.m. Dia Bore Filled With Pea Gravels (3 -6 m.m.)
Slotted Pipe
Depth Variable As Per Water Table
160 Ø PVC Slotted Pipe
Ball Plug
500 M.M.
Section

**Waste water treatment**

Intent is to avoid damaging receiving streams, treat waste water generated on site so that it can be reused or safely disposed of. Because of the scarcity of fresh water and the necessity for recycled water for various reasons such as flushing and landscaping, installing a sewage treatment plant reduces the amount of fresh water used. The project is providing an on-site sewage treatment system to treat 100% of waste water generated through MBBR Process. The project is using this treated water for flushing & landscaping which will comply standards suitable for respective purpose. STP of capacity 190 KLD is proposed to treat the domestic sewage water in a scientific manner through a properly planned sewage/effluent treatment plant. The objective is to stabilize the decomposable organic matters present in sewage so as to get an effluent and sludge having characteristics which are within safe limits, and which can be recycled and re-utilized for various purposes to help in maintaining the ecology of nature and save energy resources.



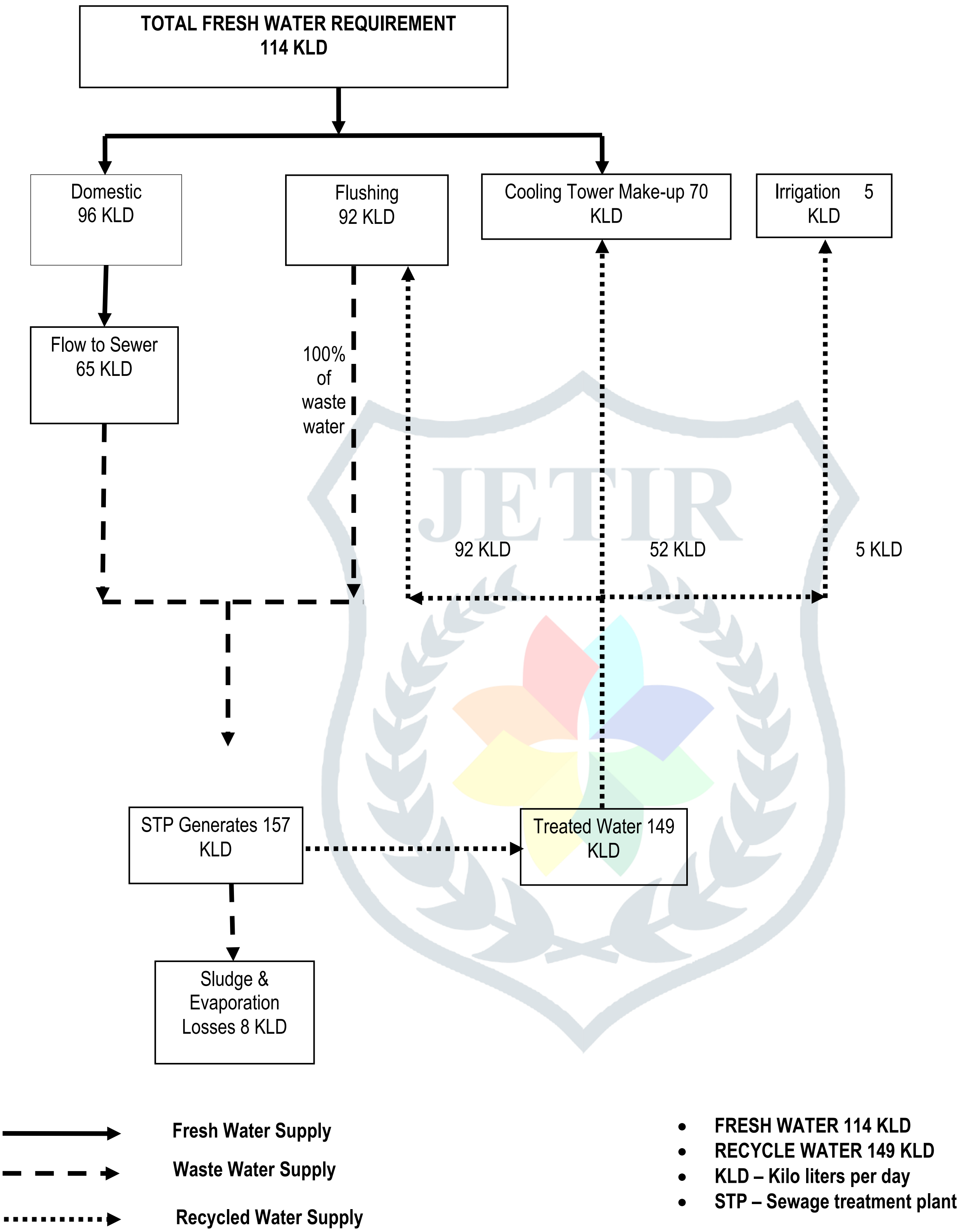

**Waste water reuse:**

The goal is to reduce dependency on potable water by using treated waste water. Demonstrate that treated waste water from a waste water treatment plant is used for irrigation, cooling water make-up, and flushing water.

The site is treated 100% of waste water generated onsite i.e. 157 KLD while 8 KLD of waste water goes in form of sludge and evaporation and gets 149 KLD of treated water which is further used for following applications:

1. Flushing (92 KLD)
2. Landscaping (5 KLD)
3. Cooling tower makeup (52 KLD

**Water balance diagram from the projected:**



**The Conclusion from the case development has been explained below:**

In this chapter, I have used an experimental case study of a traditional commercial office building in Noida, to analyse the current state of water management. Here, I'll look at the current water distribution system and compare the findings to the water efficiency that can be attained when sustainable water approaches are implemented. A G+10 storey building with a capacity of 2020 people has been presented as a case study. The required water demand for this building, according to NBC guidelines, is 263 KLD. If we adopt water management strategies in this typical building, we will be able to determine how much water is saved after and according to NBC water use per person and overall water demand once these approaches have been implemented. Also, I have deduced a few interventions that can be made to improve water efficiency and water conservation from the IGBC guidelines and water certification requirements that were discussed above in the research.

First, the analysis was done on the basis of **smart water fixtures** and how much water will be saved when they are placed in a traditional structure.

The current water demand was calculated for approx. 2020 people in the building on a daily basis. Over 90% of them are likely to be employees, with the remaining being visitors. It is estimated that the building will demand 263 KLD of water per day based on our calculations and derivations from NBC. Water consumed by staff and visitors, as well as water used by building services such as ventilation and cooling, are all included.

In the study further I've jotted down how many water fixtures are required for 2020 people, consumption rate, and water uses per day in litres, all according to NBC regulations. Through this we find that total water usage through traditional fixtures is roughly 66436 litres per day, or 66.4 KLD.

Installing efficient water fixtures and reusing STP treated water for flushing reduced potable water consumption. To reduce indoor water usage, IGBC-compliant water efficient flow fittings for faucets, taps, urinals, and toilet flush fixtures are fitted. Through this analysis we concluded that total water consumption through smart fixtures is around 29036 litres per day, or 29 KLD.

As a result, smart and efficient fittings save roughly 43% of the water consumed by standard fixtures in office buildings.

Also, from the inferences from the case studies we have analyzed the number of uses per day as per consumption rate.

After that in the proposed case the analysis was done on another parameter of water conservation i.e, **rain water harvesting** where in it was noted that rainwater is transferred from the rooftop to the drainage system using rain water pipes. For recharging structures, the whole Complex is proposed to be subdivided. For the desired purpose, de-silting tanks and recharge wells are recommended. Rainwater will be channelled into a de-silting tank to remove inorganic impurities, and the de-silting tank's output will be pumped into the recharge well. Thus, it was concluded that all the water saved from rainwater is utilized for ground water recharge.

Next in the case we have designed a prototype for **waste water treatment** in the building where we calculated that about 157 KLD waste water is generated in the building as per calculations.

While 8 KLD of waste water can be converted to sludge and evaporated, 149 KLD of treated water is produced, which can then be used for flushing (92 KLD), Landscape design (5 KLD), Makeup for a cooling tower (52 KLD).

Thus, the freshwater requirement came out to be 114 KLD and it is speculated that the **waste water reuse** can be used as for domestic purposes 96 KLD, for flushing 92 KLD, for cooling tower makeup 72 KLD, and for Irrigation 5 KLD.

Hence the difference in percentage of total water requirement which was 263 KLD to the fresh water requirement that is 114 KLD was calculated to be 56.6% .

Hereby we concluded from our experimental case of a conventional office building that if we use water efficient techniques and follow sustainable water management guidelines we can conserve overall 56.6% of water which will not only help in lowering the overall maintenance costs but also the lifetime costs of a commercial building as well as help in making the environment cleaner and greener.

**Conclusion and recommendation**

As the earth's population continues to grow, the demand for water increases. The United Nations predicts that the earth's population will increase to 9 billion people by the year 2050, resulting in a significant need for water. Water is an essential resource for life, and is a requirement for the operation of business. Water conservation is an important part of operating a building efficiently. It provides many benefits, including lower operating costs, reduced environmental impact, and improved occupant comfort. Water is a vital resource, and the most efficient buildings use much less water than conventional buildings. However, water is also the single largest operating cost for most buildings. The importance of water conservation in office buildings can't be overstated. Office buildings are the single largest sector of commercial buildings, and the largest water consumers. The water used in office buildings comes from a variety of sources, including private wells, public water systems, and surface water. The worldwide water crisis is currently one of humanity's most pressing issues. As a result, worldwide environmental groups have imposed a number of required laws in various areas with the goal of improving water management by minimizing the usage of potable water. Different approaches for promoting water sustainability in buildings have been explored and their benefits have been highlighted in earlier studies.

The literature analyses the principles of the water quality cascade in regard to commercial building water management, alternate water supply options, and various water saving technology that can be applied in commercial buildings. Such efficiency methods are fair to implement in the attempt to achieve sustainable water consumption in buildings. It is argued that use of such ideas in growing economies such as India would be a fundamental necessity, given causal elements such as population explosion, urbanisation, and rapid development. Also, not only this using these techniques in old and obsolete office buildings (mostly government)can help in cutting the operations and maintenance costa of those buildings an also help in making them in par with new technologies. The necessity for water conservation has become so much significant that recently LEED rating system has doubled the points under the water efficiency category to ten from the previous quantity of five. Also, the sustainable buildings criteria provided by IGBC have been studied to understand how following water efficiency parameters can make a building sustainable.

Using a case development study of an office in Noida, this study demonstrated the usage of better water management and provided novel wastewater ways. The issue of lack of adequate water conservation metrics is highlighted based on the literature review. The case development study underlined the water management in a conventional office building in Noida, India and sought out methods of water saving techniques through which it can be made sustainable in respect to water efficiency. It proved to be successfully saving 50% water by using these water efficient techniques in the building.

According to the literature study, the government should implement a required policy for both the public and private sectors in order to ensure proper water management. The case study examined in this paper should assist private investors and government agencies in comprehending the economic benefits of incorporating innovative technologies such as low-flow fixtures in sustainable design buildings. Due to the overlap between these challenges, there is also a lot of possibility for merging components of energy management and water management. This can be beneficial in terms of increased benefits and lower costs.

To make these types of systems a reality, regulatory authorities and councils will need to include the aforementioned concepts into development controls and regulatory guidelines in order to increase and secure the adoption of innovative commercial building technologies and practices. It's also necessary to set up demonstration projects that track and analyse the cost savings and advantages of these structures.