"POTENTIAL RETROFITTING OF EXISTING CAMPUS INTO GREEN BUILDINGS"

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Abstract: Green building is building that the focus is to maximize the energy efficiency and resources used. While, retrofitting is the process of renovate or refurnish the existing building. Therefore, by retrofit existing buildings that comply with green building requirement, it improves the environmental attributes of the buildings. A green building uses less energy, water and natural resources, creates less waste and is healthier for the people living inside compared to a standard building. Green building provides suitable environment by controlling solar radiation temperature, energy efficiency, water conservation using domestic treatment plant and indoor air quality. The main aim of green buildings is to reduce the environmental impact of new buildings. Green Building refers to a structure that is environmentally responsible and resource-efficient throughout a building's life-cycle. In the present project we have proposed to retrofit the existing campus into green buildings in order to improve its performance.

Index Terms - Green Building, Wastewater Treatment, Grey Water Filter, Biogas, Rainwater Harvesting, Solar Power Generation.

I. INTRODUCTION

As the population is increasing, more and more buildings are required to fulfil their needs, trashing more natural resources, and impacting the environment. Hence a new concept of eco-friendly building or 'Green Building' is emerging rapidly. Green building on college campuses is the purposeful construction of buildings on college campuses that decreases resource usage in both the building process and also the future use of the building. The goal is to reduce CO2 emissions, energy use, and water use, while creating an atmosphere where students can be healthy and learn.

Fig-1: Parameters defining green building concept

Green Structure is clean environment, water and healthy living. Green building is not about a little more efficiency, it is about creating buildings that optimize on the local ecology, use of local materials and most importantly they are built to minimize power, water and material requirements.

Importance of green building:-

Some of the top green buildings in India are,

- Solar Air Conditioning: Turbo Energy Limited, Chennai. The solar air conditioning in Turbo Energy systems in Chennai uses solar power to Condition or control the air in the building by passive solar, solar thermal energy Conversion and photovoltaic conversion in which sunlight is converted to electricity.
- Earth Air Tunnels and Passive Cooling: Aqua mall water solutions, Dehradun and Police Bhavan, IGP office
- Gulbarga Earth tunnel Air conditioning system also known as passive air conditioning installed in Aqua mall water solutions in Dehradun, is a wonderful utilization of nature. The system sucks in air from the outside and with the help of geothermal cooling the air is sent to interiors.

- The IGP office in Gulbarga uses Passive downdraught evaporative cooling (PDEC) system where air passes through a layer of water in the wind tower. This cools down the water and that water is sent to the interiors of the building which is similar to the Earth tunnel air conditioning system.
- Thermal Storage: TCS Techno-park and Grundfos Pumps, Chennai. This is achieved with the thermal energy systems which collect energy and store it for later use, even months later. This also works inter-seasonally where during winters it uses the solar heat collected in the solar collectors and during summer it uses the cold air conditioning obtained from the winter air.
- High Performance Envelope: ITC Royal Gardenia, Bangalore. ITC Gardenia in Bangalore has reduced heat gain to large extent by their design and. Have experienced serious energy savings.

OBJECTIVES

- To adopt techniques to convert the selected building into green buildings
- To reduce demand of potable water & generate the new source from reuse for gardening purpose
- Promoting smart growth and sustainable development
- Minimize non-renewable energy consumption
- To recommend appropriate waste handling & disposal measures
- Limiting all kinds of pollution during and after construction is also aimed at to ensure reduced impact on surrounding environment. These buildings ensure proper safety health and sanitation facilities for occupants.

LITERATURE REVIEW

1. A Survey of The Status and Challenges of Green Buildings Development in Various Country (2019) Danniel M Kammen, - Green building is subject to continuous development of new technologies, integrated management of building operation, consistent standards of certification systems, and proper adjustment of policies, all of which have a significant impact on GB development.
2. Green Retrofitting of Educational Complex (2018) Alok V. Thacker and Deepa A. Joshi - Green retrofitting' concept is studied in detail. A case study of existing educational complex has been carried out and IGBC rating for the same has been determined. Also, the existing facilities and the recommendation are given point wise, considering IGBC guidelines cost analysis for implementing the Green Retrofitting to the selected educational complex has been carried out
3. Innovations in Transforming A Traditional Building into Green Building (2018) Sneha Hajare and Shubham Thorat - By implementing the mentioned green concepts, we can transform an existing building into a green building which will save approximately 20-22% of energy consumption
4. Biogas Generation from Biodegradable Kitchen Waste (2017) Srinivasa Reddy - The gap between demand and supply for energy sources can be reduced by converting Bio degradable kitchen waste into a biogas.
5. Comparative Study of Conventional and Green Residential Building (2017) Manoj Visvas and Rahul Ved - Coped with production of bio waste which can be converted to bio gas, thus reducing the burning of other fossil fuels. Effective treatment of grey water that can be used for gardening, flushing etc. Harvesting rain water in order to reduce deal with water scarcity in dry period. Solar panels help to produce necessary amount of electricity for household purposes.

METHODOLOGY

The following methodology has been adopted in the present study.

1. **GREY WATER**-: It can be defined as any organic waste water produced, excluding sewage. The main difference between grey water and sewage is the organic loading. Sewage has a much larger organic loading compared to grey water.

   Two major benefits for grey water use are:

   - Reducing the need for fresh water. Saving on freshwater use can reduce household water bills, but also has a broader community benefit in reducing demands on public water supply.
   - Reducing the amount of water entering sewers or onsite treatment systems. Again, this can benefit the individual household, but also the broader community.

Design of Grey Water Filter

As per Manual for Design, Construction Operation and Maintenance.

Following layers are present

I. 25 cm gravel layer at bottom

II. 10 cm gravel layer at top

III. Two 10 cm M sand

IV. Two 10 cm charcoal layer

V. 60 cm sand at middle

Thickness of layer = 10 + 25 + (2 * 10) + (2 * 10) + 16

= 1.4m

Approximately 339 litres of grey water produce per house per day. In order to accommodate 339 litres a portion of 0.8 m * 0.7 m *0.7 m is required.

Therefore, total depth of the tank = thickness of layers + 0.7 = 1.4 + 0.7 = 2.1m

Fig 2: Grey Water Filter

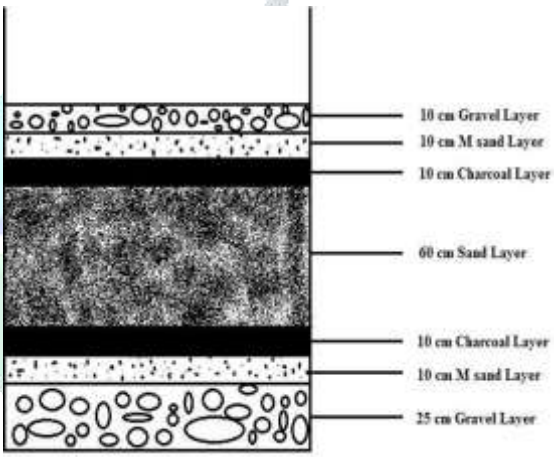

Fig 3: Thickness of each Layers in a Filter

RESULTS: - All the values are under the limit as per the required specifications

	Characteristics	Before Filtration	After Filtration (4 hours)
Sample	PH	8	7
	Hardness(mg/l)	312	260
	Concentration of Sulphates(mg/l)	26	25
	Concentration of Chlorides(mg/l)	565	405
	DO(mg/l)	3.3	5.8

	Carbonate Alkalinity(mg/l)	**204**	**180**
	Bicarbonate Alkalinity(mg/l)	**184**	**180**

2. **BIOGAS** -: Biogas typically refers to a mixture of different gases produced by the breakdown of organic matter in the absence of oxygen. Biogas can also be produced by anaerobic digestion with anaerobic organisms, which digest material inside a closed system, or fermentation of biodegradable materials. Biogas is primarily methane and carbon dioxide and may have small amounts of hydrogen sulphide, moisture and siloxanes. This energy release allows biogas to be used as a fuel. It can also be used in a gas engine to convert the energy in the gas into electricity and heat.

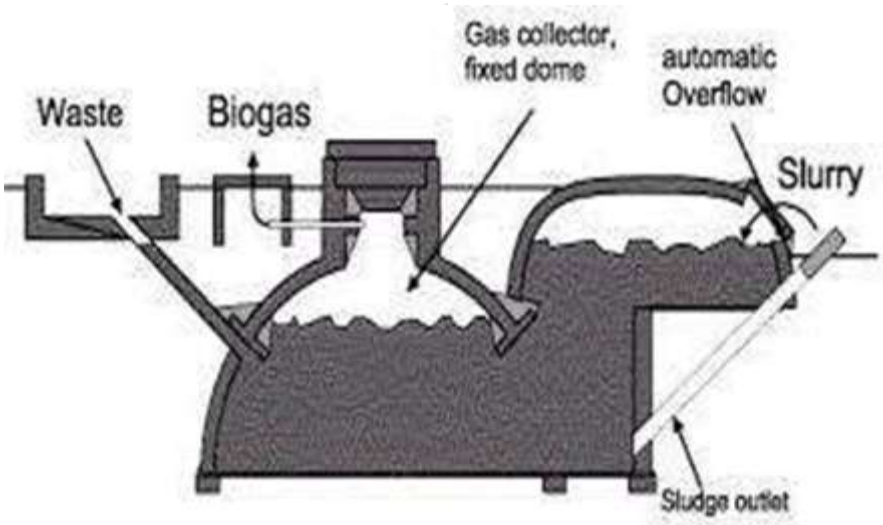

Fig 4: Components of Biogas.

Energy Calculation

For cooking

For food waste maximum gas production per kg = 0.05 m^3

Total gas = Total food waste in kg * 0.05

Medium stove uses 9 MJ of energy per hour.

For about 24 kg of food waste produced,

24*0.05 = 1.2 m^3\

Duration to run the stove of 1.2 m^3 dung= 1.2 * 19 MJ (1m^3 = 19 Mega Joules) = 22.8

Let 22.8/9 = 2.5 hours

About 24 kg of food waste is used as fuel to run the stove for 2.5 hours**.**

3. **SOLAR POWER GENERATION: -** In solar photovoltaic system solar energy is directly converted to electric power. This makes the system far more convenient and compact compared to thermal methods of solar energy conservation. It uses the energy of visible and infrared regions of the solar radiations for conservation into electric power.
    - Roof area for solar installation = 5000 sqft.
    - Space required for 1 KW Panel = 70–80 sqft
    - Hence, 5000 / 80 = 62.5 KW = 60 KW.

➢ If in place of Incandescent lamps, we use CFL lamps of 15 watts then we can save up to 205.065 KWh per month and in place of Fluorescent tubes if we use LED tubes of 18 watts then we can save up to 216.876 KWh per month. That is a total of about 422 KWh/month and around 10-12% of total energy consumed in the building

Fig: 5 Solar panel system connection

4. **RAINWATER HARVESTING**: - It is the collection and distribution of rainwater for using in daily life, rather than allowing it to run off. Rainwater is generally accumulated from roof tops. Then it is deposited in a reservoir with percolation. It is used for gardening, cultivation and domestic uses. The harvested water can also be used as ground water recharge.

Water shortage is caused by climate change, lack of planning of water uses, rapidly increasing water pollution and increasing population. So, under such conditions some serious steps towards conservation of water must be taken. Rain is a natural source of water. So, if it can be collected and treated, it can be used as portable water. It is a cheap and simple technology, so it can be easily installed in normal households and a lot of water can be saved.

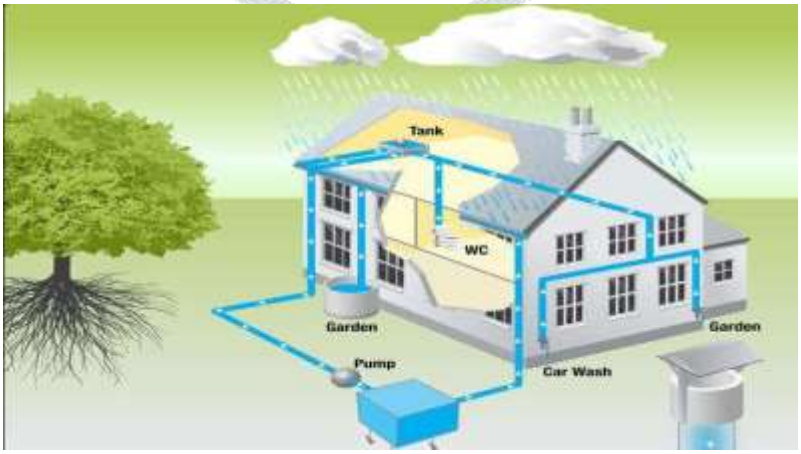

Fig no. 6 Representation of Rain Water Harvesting

4.1.5 Design of Rain Water Harvesting Plant:

Average rainfall in the area

= 2806.7 mm = 2.806 m

Area of catchment or roof top

= 8.8*9.44 = 83.072 m²

Total rainfall = area * average rainfall

= 83.072 * 2.8

= 259.588 m³

= 233100.03 litres

Runoff Coefficient = 0.7

Coefficient of evaporation, spillage & first flush = 0.8

Total amount of rainfall = 259588.67 * 0.8 * 0.7

= 145.369 m³

= 130536.01 litres

Tank capacity has to be designed for dry period i.e., the period between 2 consecutive rainy seasons with monsoon extending for 4 months, the dry season is of 245 days.

Drinking water requirement of a person per day = 10 litres

Drinking water requirement for 3 persons = 3 * 10

= 30 litres/day

Amount of water required for 245 days = 30 * 245

Safety factor = 20%

= 7350 litres

Water required = 7350+20% of 7350

= 8820 litres

Storage tank: Length = 3 m

Width = 3 m

Depth = 1 m

Although most technologies focus on creating greener constructions, new advancements are constantly being developed to help both organizations and homeowners reduce waste, environmental degradation and pollution so that impressive economic, social and environmental benefits can be achieved. One of the best examples of green building practices is rainwater harvesting.

Conclusion:

In India some world class Green Building are constructed in past years, but a large investment of existing building need to be Green Retrofitted. The fast paced growth in economic and human activity across the global has put environmental resources under tremendous pressure thereby becoming a cause for irreversible damages to the environment at large and putting the quality of life of future generations to unknown risks. The increasing apprehension towards the environment is pushing the policy makers seek sustainable solutions, leading to the origin of the theory of green buildings. In the present work, 'Green Retrofitting' concept is studied in detail. A case study of existing educational complex has been carried out and IGBC rating for the same has been determined. Also, the existing facilities and the recommendation are given point wise, considering IGBC guidelines cost analysis for implementing the Green Retrofitting to the selected educational complex has been carried out.

Following are the major conclusions derived:

• Green Retrofitting is very much essential and the awareness among all stakeholders is required to be created.

• As per recommendation suggested 30% of portable water has been saved from Low flow plumbing fixtures. And 50% of rain water harvested from roof and no roof Areas which heads to concrete sayings.

• The Pay-back period of "LED Retrofitting" and "Renewable Solar Energy" is 3–4 years and 5–6 years. Which is very cost effective for institute.

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