

GREEN BUILDING APPROACH FOR PLANNING AND DESIGNING SUSTAINABLE BUILDINGS

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Abstract - In this paper, the green building concept is used in the planning and design of a sustainable building that conserves energy by using (Solar panels, efficient HVAC systems, low energy consumption lighting fixtures), conserves water by using the concept of (Rainwater harvesting, recycle and reuse of sullage water), and uses eco-friendly construction materials, resulting in reduced pollution and the effect of global warming, which is a serious problem for the world.

Key Words: Solar Panel, HVAC System, Sustainable Building, Rainwater Harvesting, Construction Material.

1. INTRODUCTION

The buildings which are designed modern consume about 20% to 30% of total energy and the percentage of fresh portable water is about 30% and generate approximately about 40% of total waste [1-2]. The buildings which are designed with the concept of sustainability results in reduction of energy and water consumption in to less than half of consumption of power in comparison with conventional buildings and also helps in complete elimination of waste which comes with construction and operation through recycling [3-5].

Now a time came when building sector in India is growing at very fast rate and significantly contributing for increase in demand of green. That results in increase of energy leads to increase of Green House Gas (GHG) emission and that rates global warming [6-8]. The Indian Green Building Council (IGBC) leads the movement of green building in India that play a vital role on reducing the effect of GHG emission by taking a significant step of improving the efficiencies in buildings and also focus on the use of renewable energy source in buildings [9-11]. The data be shown on green buildings that about 25% - 30% reduction of consumption of

energy compare with national baselines, that can be achieved by implementing several technologies and energy efficient practices [12-15]. In availability of space on site end cost economics, the implementation of green buildings also done by onsite and offsite renewable energy generation to meet the required extent of about 15% [16-20].

Green building ensuring the practice of creating structure using processes that are environmentally responsible and resources efficient a whole building's life cycle from design siting, construction, operation maintenance, renovation and deconstruction [21-23]. This are results in expansion of classic building design. It is also known as sustani9able or high-performance building [24-27]. Modern trends toward sustainable buildings are clearly obvious in new construction as architects and contractor focus or using green techniques in focus of building as well as making of sure the buildings follow eco - friendly [28-30]. There are major steps to be taken to make the existing buildings follow same opportunities of green living that are be put in new buildings.

Green buildings are designed in a way to reduce the overall impact on environment that is issues of health for humans by following methods [[31-33]:

- ❖ Reducing pollution, degradation of environment.
- ❖ By proper use of energy, water and other resource.
- ❖ By protecting health of occupant and improves the productivity.
- ❖ The concept of green building in increase gradually in India. Green Building typically applies the practices like harvesting of energy, water and using of materials which is eco-friendly. There are many more advantage of implementing of green building like low waste disposal, low energy, water lost and low emission cost.

2. METHODOLOGY

The following methodology has been adopted in the green building:

2.1 Vertical Gardening

Vertical Garden is a type of garden that grows upward (vertically) by the help of trellises or other support system rather than or the horizontal. The wall that is green walls or living walls are self-sufficient vertical garden that attach with either interior part or exterior part of building. This garden directly improves the beauty of garden and rapidly increase curb appeal by adding character, variety, structure and colour. Creating of eye candy by plantation at level of eye with vertical garden structure like hanging window boxes. Putting a green wall in buildings acts as fresher of air, balancing humidity levels. It improves both air quality indoor and outdoor by removing vertical compounds and also helps in absorbing the pollutants.



Fig -1: Vertical Gardening

2.2 Vermin Composting

It is the composting that is the end product of a process called vermin composting, which uses the earthworms. It increases the speed of composting process by improving the quality of compost. It is very essential what ends applied in garden. If we have to increase production capacity, solid waste that came from homes like food waste, raw waste, low dung etc. Ultimately the vermin composting results in rich, black earthy smelling composted that ensure the growth of health gardener. This cast vermin also known as worm casting is excrement of worm which minus the rest of compost. This plant is installed on black side of buildings which is in plot area. The area of plant includes about one meter wide, 1m length and 0.8m depth [3].



Fig -2: Vermin Composting

2.3 Grass paves

It is the paving tiles which consists of number of rhombus shaped opening so that water can flow through ground and thereby helps in increasing the level of ground water. By using this product, it allows the water which is present at surface allows to seep into aggregate and that slows the runoff that would happen in asphalt surface. This paves primarily use in area where soil erosion occurs or drainage of water. It also helps in to stabilizes the soil in an area where lots of vehicular traffic may occur. It helps in controlling and containing the water pollution. It is a small sized area in which both side of building around 26 square meters of building. It is highly durable and use in driver way near the parking lot.



Fig -3: Grass Paves

2.4 Solar Power Plant –

This plant is largely used in development of solar power generation. In this it is installed in roof of building. The roof tables consist of solar PV cell that convert sunlight to generate electricity through photovoltaic cell. These are basically two types of solar PV system.

❖ **Off grid system** – It not directly connected to electricity grid therefore it requires battery storage. It must be designed properly for generation of proper power throughout year and enough capacity to meet house requirement even when winter comes when less light occurs.

❖ **On grid or grid tie solar system** – These are by far most common and wide use for homes and business property. These are basically use in systems that are connected to the public electricity grid and also requires battery storage. Any solar power that you generate by this system is exported onto electricity gride.



Fig -4: Solar Power Plant

2.5 Aluminum Paint

It is a type of coating material that consist of resin base filled with flecks of aluminum flakes gives the paint to shiny and metallic finish. This type of paint helps in finish of salivary and major of manufactures only produce shade of aluminum paint cast.

2.6 LED lighting

It is up to 80% [3] more efficient than traditional lightning such as fluorescent and in can descent lights. About 95% [3-4] of energy in LEOs converted directly to light and only 5% [3] is goes on heat. In fluorescent light 95% of energy goes waste to form heat only 5% uses in light making. It also consumes less power about 84-watt consumers fluorescent light and about 36-watt LED at same energy level. It directly has effect in decrease of greenhouse gas emission.

2.7 Rain Water Harvesting

It can be defined as activity of direct collection of rain water and its storage as well as other thing aimed towards harvesting and conserving surface. Prevention by these loss through evaporation, seepage and other hydrological studies, many other inventions made for efficient utilization of rain water towards best use. The building which can be made in future in urban areas have provision for roof top rainwater harvesting with minimum capacity of 5KL [5] for area above 200 sqm. For residential building and minimum capacity of 0.01 cum per sqm of area in case commercial and institutional buildings such as tourist complex, hotels, shopping complexes and in government buildings. Rainwater harvesting system design and installation includes:

- ❖ Catchment and conveyance: To transportation of rainwater.
- ❖ Filter: Mainly rapid sand filter used to filter rainwater.
- ❖ Storage tank: To store filtered rainwater.

2.8 Materials

❖ **Clay fly ash bricks** – It is one of the most important materials which is used or select for buildings about 20 % to 50% [4] of fly ash depended upon soil quality it can be mixed to form fly ash bricks by two processes either by conventional or mechanized process.

❖ **Stabilized mud fly ash bricks** – The mud fly ash which is in compacted which is in compacted from can be stabilized by lime, cement or other chemicals it can be made easily. Problem with this dry fly ash is when it used at site it makes adoption of this technology is difficult.

❖ **Calcium Silicate Bricks** – These bricks also known as sand lime bricks using fly ash in place of quartz sand. In this formation of bricks involves a low- or high-pressure compaction followed by two processes.

❖ **Low pressure stream curing.** – Autoclaving under elevated hydrothermal conditions. These bricks are formed with high pressure technology.

❖ **Mixing with cement** – It is formed with mixing of above 10% to 20% [4] of dry fly ash with clinker during cement manufacturing or formed with blended with finished of Portland pozzolana cement (PPC).

❖ **Autoclaved Aerated Concrete** – This type of concrete can be formed by a process of involving a mixture of fly ash, quick lime, involving or gypsum in a very high speed of mixer to from slurry. These materials considered to be very good products for block walling and for floor slabs.

❖ **Cellular Light weight Concrete** – It can be manufactured by a process that involves the mixing of fly ash cement. These products mainly used in high raise construction by reducing the dead weight of structure.

❖ **Sintered Light weight aggregate** – It substitutes stone ships in concrete reducing dead weight. It can be used for several purpose such as structure light weight concrete buildings unit for uses as load and non-bearing elements. This material has good potential in a place where fly ash is locally available.

❖ **Cast in- situ fly ash walls** – By mixing of fly ash in cast – in – situ wall we can achieve 20% [4] of economy, quicker construction good finish on both the sides of walls which eliminates pestering and more carpet area. Similar type of walls can be cast using Fal G Cement.

❖ **Fly ash – stone powder** – cement bricks – These can be manufactured by mixing of weighed amount of fly ash, cemented ad size stone powder in a mixer and mounded and presence in bricks making machine. Other materials that can be used like bamboo ply board, wood plastic and eco – friendly construction chemicals etc.

❖ **Grey water system** – Grey water alludes to the homegrown waste water which is depleted out barring the waste water from kitchen sink and the water wardrobe as they have high grouping of natural matters. In request to preserve water this water can't be simply emptied out yet ought to be reused and reused. The advantage of utilizing reused dim water is that it is an enormous source with low centralization of natural matter. The restroom dark water

comprises of waste water from showers, baths and wash bowls. It has an exceptionally low centralization of natural matter. The different wellsprings of dark water are from washing of garments, vehicle washing, and so on. As indicated by different investigations, a typical family creates 140 litter of dark water each day.

3. STUDY LOCATION

The Expansion of the purposed area “The Sahara Estate Green Building Project” in Gorakhpur (Tara Mandal Road), Uttar Pradesh. It is located near the southern extremities of the Ramgarh Taal area in Gorakhpur. - U.P. & at about 460 m SE of Tara Mandal and about 380 m NNE of Circuit House.

We are taking the 2250 square meters area in Sahara Estate at Tara Mandal Road in Gorakhpur. According by buildings laws we are using only 40% area for building construction. So, we are taking only 850 square meters for the construction.

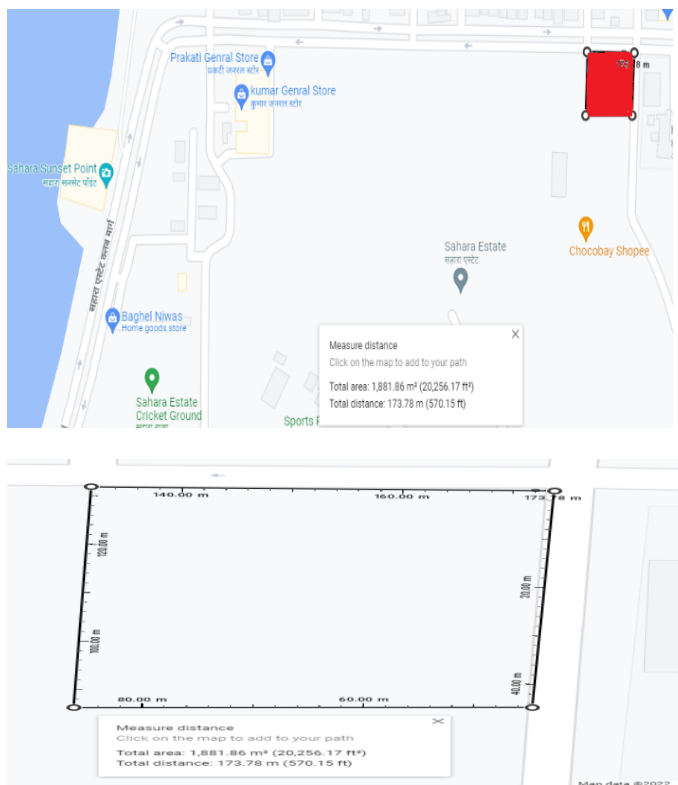
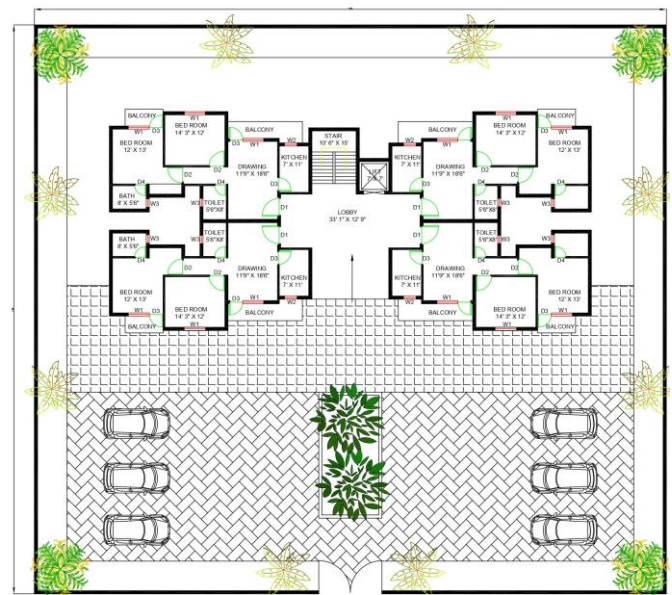


Fig -5: Satellite View and Plot size

AutoCAD for Sahara Estate Location in Gorakhpur has been given in Fig.6.



GROUND FLOOR
Fig -6: AutoCAD Plan

4. RESULT AND DISCUSSION

The outcomes of various methods used in green building implementation:

- ❖ **Vertical gardening:** When the air temperature climbed, the effective thermal resistance of a plant layer gradually reduced. On the other hand, as wind speed increased, so did the difference in internal facade surface temperature between bare and planted façades. These effects reduced the heat inside the building material, making it cooler. It may be concluded that the weather around the building has an impact on the functioning of the vertical garden.[6].

- ❖ **LED Lighting:** The initial investment is greater than that of fluorescent lights, but the shelf life is greater than that of any other artificial lighting source. When compared to fluorescent and other illumination sources, LED lights have a lower life cycle environmental impact. Most fluorescent bulbs were found to contain up to 40 mg of mercury, contributing to environmental pollution and posing a long-term health risk to humans through neuropsychological damage.[7].

- ❖ **Solar panels:** It can save up to 20% on energy bills. It is suitable for use in remote areas. Simple Setup (i.e. does not required any wires, cords etc.). No extra space is required, and any home or commercial user can generate their own electricity. It is a free, environmentally friendly, and renewable resource that is readily available. It has no

moving parts and generates energy solely from sunlight. Water and fuel are not required.[8].

❖ **Grey water system:** Greywater treatment technologies have the potential to play a significant role in future water management and sustainable living. It is a process of water regeneration that uses least amount of freshwater and produces the least amount of effluent. The treated water is good enough to use for gardening purposes, vehicle washing, etc.

❖ **Comparison of Green Building and Conventional Building**

Table -1: Comparison of Green Building and Conventional Building

Type	Conventional building	Green Building
Energy Consumption	High	Low
Building Materials	Font	Eco- friendly
Waste Management	Less - efficient	High - efficient
Indoor environment quality	Good	Very Good
Emission	High	Low
Construction practices	Normal	Sophisticated
Water efficiency	Low	Very high

Calculations for Conventional Building:

Here for this sustainable residential Building required 35 KW system required.

1 KW generates 5 units per day.

Hence for 35 KW= 35X5 = 175 units per day.

Electricity Cost for per day = 175 unit's X 7 Rs. Per unit = 1225 Rs. per Day.

Electricity Cost for a month will be = 30 X 1225 = 36750 Rs. per Month.

Electricity Cost for a year will be = 12 X 36750 = 441000 Rs. per Year.

Hence, for the Life of 25 years Energy cost for conventional building will be,

$$= 25 \times 441000 = \text{Rs } 11025000. /25 \text{ Years.}$$

Calculations for Green Building: -

To install 35 KW solar system, plant Initial cost will be as follows:

For 1 KW approx. 70,000 Rs. Costs required (as per GOI, ministry of new and renewable energy). Hence for 35 KW = 35X 75000 = Rs. 2450000/-

So, if we compare conventional building and green building then the cost of electricity is equalized only in 5 years approx.

Calculations for Rainwater harvesting: (all data as per CPWD)

Here, rooftop rainwater harvesting used.

$$\text{Total rooftop area(m}^2\text{)} = 800$$

$$\text{Average annual rainfall(mm)} = 1228.1$$

$$\text{Catchment runoff coefficient} = 0.85$$

$$\text{Coefficient for evaporation, first flush, etc.} = 0.80$$

$$\text{Effectively harvested water} = \text{area(m}^2\text{)} * \text{rainfall(mm)} * \text{coefficients}$$

$$= 668086.4 \text{ litre}$$

Using green building approach in given plan 668086.4 litre of water can be saved.

5. CONCLUSIONS

Finally, we conclude that there are no structures that can operate with zero carbon emissions. However, green building is an amazing addition that can reduce the impact of human behaviours on the environment. The recycling and reuse process is an essential component of green building. Given the political difficulties of obtaining energy and the likely future scarcity of conventional energy sources, we can't ignore the massive conservation that green buildings enable. Taking everything into consideration, we can conclude that green building is conducive to reducing energy contribution, saving land resources and water use, meeting time requirements, and improving people's quality of life.

The rating system enables reduction in consumption of energy and use of appropriate renewable energy source can help to meet all the requirements of energy. The benefits of adopting the concept of Net Zero is given below –

- ❖ The improvement of energy efficiency results in reduction of annual energy consumption of about 25% – 30% compare with national baseline.
- ❖ It also makes effect in reduction of energy cost at least about 30%.
- ❖ The energy stored device combined with renewable source of power supply.
- ❖ The concept of Net Zero Building increased the daylight and increasing the comfort for occupancies.

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