Energy Efficient and Eco-Friendly Building

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Abstract— The building sector alone represents about 35% energy consumption. Realizing the situation, the need of the hour is to modify the building sector in accordance with the changing environment. Taking into account the current scenario, a building should be environmentally friendly and sustainable and also focuses on the efficient use of energy, water, waste and building materials. According to the scientific community, climate change is happening and its effects will have severe consequences for our society and environment. Reducing energy use in buildings is one of the most important ways to reduce humans' overall environmental impact.

Keywords: Eco-Friendly Building, Fly Ash Bricks

I. INTRODUCTION

The scale of urban expansion in India is and will continue to be enormous, driven by economic and population growth. The construction and use of buildings, driven by rapid urban expansion, is likely to impose tremendous pressures on the natural environment. Today's infrastructure investments will play a critical role in determining future resource intensity and affect India's ability to decouple resource.

A Energy Efficient and Eco-friendly building is a sustainable building that has minimal impacts on the environment throughout its life. It is also called as Green Building For the purposes of this report 'green building' is understood to mean construction on that makes efficient use of energy and resources in every aspect. This includes the production of building materials, and the design, use and eventual demolition of a building in any sector (commercial, residential, industrial, public buildings) and at all stages, from new buildings to "retrofitting" or adapting existing ones.

The construction sector, which accounts for 10% of global GDP, has direct and indirect impacts on the environment. It produces 20% of global greenhouse gas (GHG) emissions, and buildings are responsible for between 30% and 40% of all material flows. Adopting green building practices would significantly reduce these environmental and resource impacts. In this paper, "energy efficient buildings" is used as a collective term for different types of buildings made to reduce energy consumption to different degrees. The research presented includes studies on low-energy buildings, passive houses, LEED buildings and green buildings.

II. CONSIDERATION

In this paper the things and mechanism which are included to make the building Energy Efficient and Eco-friendly Building are Building Materials (Bricks, Concrete, and Glass), Solar Energy, Vermicomposting, Rainwater Harvesting and Drip Irrigation.

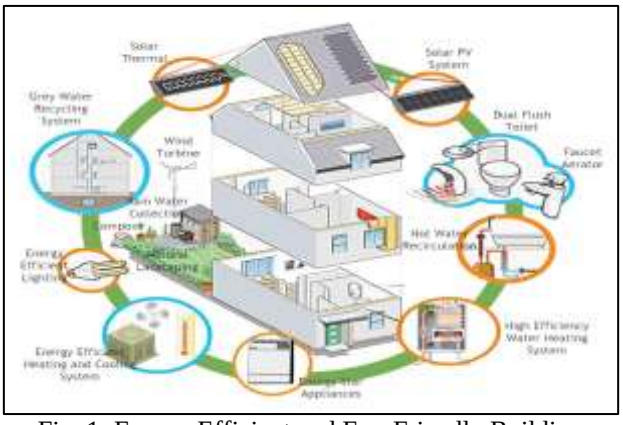


Fig. 1: Energy Efficient and Eco-Friendly Building

A. Building Materials

In this scenario the big issue is emission of CO_2 (Carbon dioxide) from different building material, In this paper the more focus on CO_2 (Carbon dioxide) gas because it contribute about 40% of the total greenhouse gas.

According to the data of Earth System Research Laboratory (ESRL)

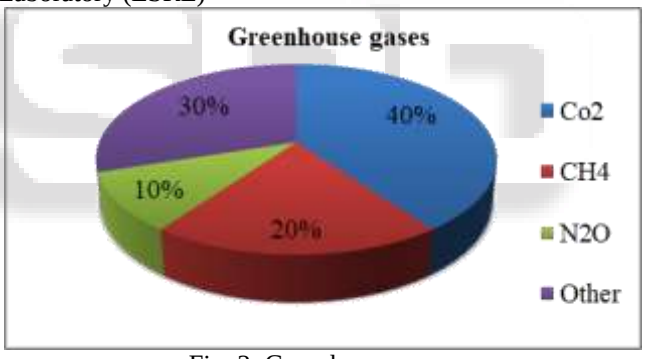
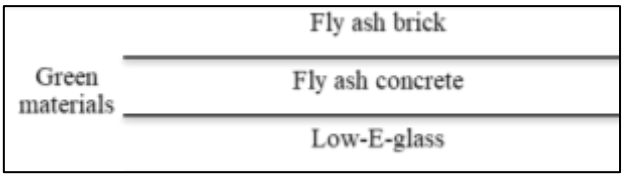


Fig. 2: Greenhouse gases

In this paper consider the main three materials which are used in larger amount and responsible for about 20% of the greenhouse gases emitted by a building during its life time i.e. (Brick, Concrete, and Glass). They are more responsible for CO_2 emission. And Replace it with Non-conventional Materials.



1) Fly Ash Bricks

The Fly ash bricks are promoted as an alternative to burnt clay bricks within the construction sector in India and abroad. These bricks are ideally suited for internal, external, load bearing and non-load bearing walls. The workability of the fly ash bricks unlike traditional clay bricks. These bricks are very economical/ cost effective nil wastage while transporting and handling.

Fig. 3: Fly Ash Brick

Ingredient	Amount
Fly ash	60%
Sand/stone dust	30%
OPC (lime +gypsum)	10%
Total	100%

Table 1: Ingredient of Fly ash brick

a) Advantages and Disadvantages:

It reduces dead load on structures due to light weight and increase the strength 1.5 times. Due to uniform size of bricks mortar required for joints and plaster reduces almost by 50%. Limitation of size. Only modular size can be produced. Large size will have more breakages.

Normal bricks	Per brick	Fly Ash bricks
0.36 kg	CO_2 emission	0.05 kg
6.5 MJ	Embodied energy	1.25 MJ
10 N/mm^2	Strength	15 N/mm^2
4 days (1200^{0}C)	Firing	Overnight (100 ^{0}C)
3.2 kg	Weight	2.6 kg

Table 2: Comparison between normal bricks and Fly Ash bricks According to (ICE)

2) Fly Ash Concrete

Building materials emits 20% of CO_2 out of total. Among of 20%, the concrete industry is creating up to 5% of emissions of this gas of which 50% is from the chemical process and 40% from burning fuel. India is the third largest cement producer in the World and one of the largest consumers of cement per capita in the world.

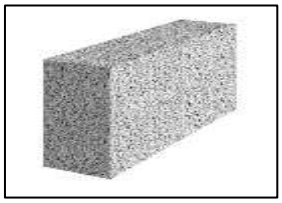


Fig. 4: Fly Ash Concrete

There have been a number of efforts about reducing the CO_2 emissions from concrete primarily through the use of lower amounts of cement and higher amounts of supplementary cementitious material (SCM) such as fly ash. Fly ash concrete can be defined as the concrete with material as a partial replacement of cement with Fly ash. It uses less energy in its production & produces less carbon dioxide than normal concrete.

According to IS code 9103, if we replace the 25% of cement with Fly ash there will be no effect of strength in the concrete. And the emissions of CO_2 will be also reducing by 25% because the CO_2 emission from the concrete production is directly proportional to the cement content used in the concrete mix.

3) Low-E-Glass

Low-e-glass (or low-emissivity glass as it is commonly referred to) is a type of energy-efficient glass designed to prevent heat escaping through your windows to the cold outdoors. Low-e glass has an invisible coating on a tempered glass which dramatically reduces heat transfer and reflects interior heat back into your room.

a) Double Glazed Unit

It is one with two panes of glass separated by a unreactive gas such as argon that improves stops heat from escaping in air drafts. The inner surface of one of the panes of glass is given a thin reflective coating, usually made from two or more layers of metal or metallic oxide (typical metals include titanium, Zinc, copper, tin and Silver).

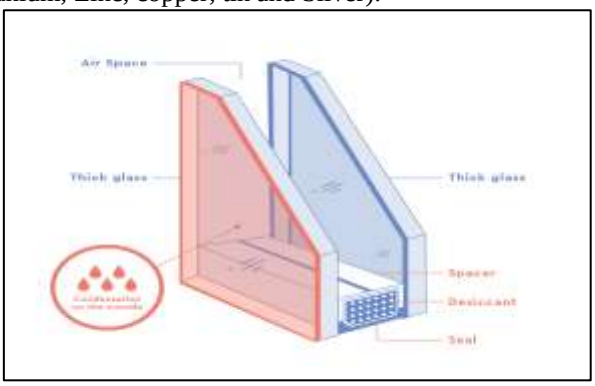


Fig. 5: Double Glazed Unit

b) Working of Double Glazed Unit

1) Cooler in the daytime in summer

Heat-reflecting glass lets visible light pass through it virtually unimpeded, but the metallic coating reflects longer-wavelength infrared light very effectively, much like a mirror. So sunlight enters your home as normal, but "sun heat" is reflected back out again.

2) Warmer at night in winter

There's an air (gas) gap between the panes of double-glazed windows, so heat can't easily escape by conduction or convection. But the warm inner pane gives off infrared radiation, which radiates through the gas between the panes to the cold glass of the outer pane and the cold night beyond.

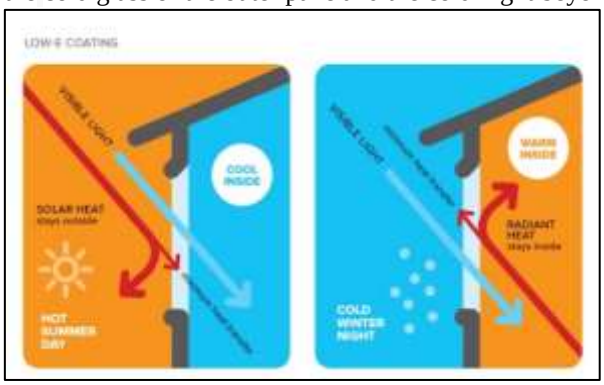


Fig. 6: Working of Double Glazed Unit

B. Solar Energy

Solar energy is the radiation from the sun that is capable of producing heat, causing chemical reactions, or generating electricity. It is the largest source of energy received on Earth. Electricity can be produced from the solar energy by photovoltaic solar cells convert sunlight.

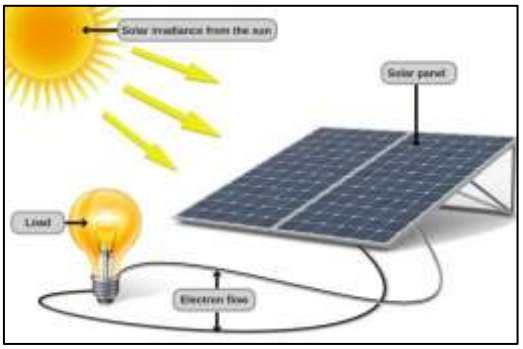


Fig. 6: Solar Energy

The solar power where sun hits atmosphere with 10^{17} watts, whereas the solar power on earth surface is 10^{16} watts. The total worldwide power demand of all need of civilization is 10^{13} watts. Therefore the sun gives 1000 times more power then we need. If we can use 5% of the energy, it will be 50 times what the world required.

1) Current scenario of consumption of electricity in India.

1) India world fourth largest electricity consumer.
2) Per person use 875 kwh per year
3) Thermal power plant fulfills 65% of total requirement.
4) India's power consumption is 5% of global consumption (5% of 10^{13} watts).

AC Fan	DC Fan
P= V*I	P= V*I
P=220*0.36	P=12*2.08
P=80 watts	P=25 watts

(Note: If we use DC appliance we can directly save 70% energy consumption.)

Table 3: Comparison of Solar Power and AC Power For Ex. (50 inches Fan)

C. Vermicomposting

It is estimated that in India 5 lakh ton of household waste are generated annually which is either burned or landfill that create a lot of problem such as land pollution, air pollution etc.

Out of 5 lakh ton waste, 25% is kitchen waste. Instead of throw this type of waste here and there or landfill. We can easily decompose that waste by using the red worm by the application of Vermicomposting.

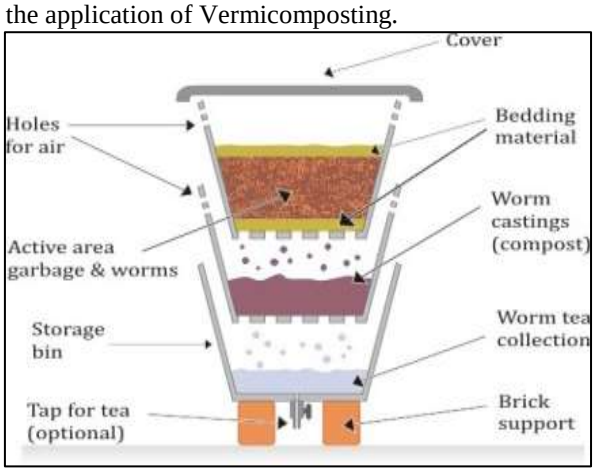


Fig. 7: Vermicomposting

It is the one of the easiest method of decomposition of kitchen wastes and to produce quality compost i.e. vermicompost. Vermicompost is stable fine granular organic manure, which enrich soil quality by improving its physiological and biological properties. It is highly useful in raising seedling and for crop production.

This compost is an odorless, clean, organic material containing adequate quantities of N, P, K and several micronutrients essential for plant growth.

Nutrients	Content
Organic carbon	20- 25%
Nitrogen	1.5-2%
Phosphorus	0.5-1.5%
Potassium	0.5-1%
Calcium	0.4-0.8%
Magnesium	0.3-0.6%
Sulphur	100-500 ppm

Table 4: Nutrient in Vermicompost

1) Advantage & Disadvantage

Vermicomposting also leads to decrease the environmental problems arising from their disposal. It involves great reduction in populations of pathogenic microorganisms. It required suitable environmental condition.

D. Rain Water Harvesting

The term rainwater harvesting is being frequently used these days; however, the concept of water harvesting is not new for India. Water harvesting techniques had been evolved and developed centuries ago.

The process of collection and storage of rainwater to fulfill the current and future demands of water for drinking, domestic purpose, irrigation or some other purposes i.e. called rainwater harvesting.

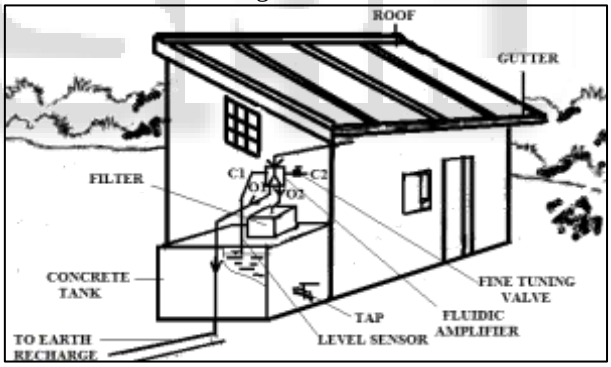


Fig. 8: Rain Water Harvesting

1) Objective of Rain water harvesting

1) Meet the growing needs and demands of water.
2) It decreases the run-off because it stops or blocks the drain.
3) Increase the underground water level and decreases the ground water pollution.
4) Decreases the corrosion of soil and complete the domestic needs of water.

a) Application of Rain water

Irrigation, Groundwater Recharge, Filter for Domestic Purposes.

E. Drip Irrigation

Drip irrigation is one of the methods of irrigation in which water is allowed to drip slowly to the roots of plants, either on the soil surface or directly on the zone, through a network of valves, pipes, tubing and emitters. It is also known as Low-flow irrigation.

Fig. 9: Drip Irrigation

When compared to other types of irrigation such as flood or overhead sprinklers since water can be more precisely applied to the plants roots. In addition, drip irrigation can eliminated many diseases that are spread through water contact.

1) Suitability of Drip irrigation

Desert areas, small and narrow areas, Places where runoff can be a problem, Steeper Slope.

III. CONCLUSION

To sum up, this paper not only contributes towards a sustainable construction and environment but it also brings lots of benefits and advantages to building owners and users. Increased comforts, healthier indoor environment quality, and enhanced durability and less maintenance costs are hallmarks of a typical Environment friendly building.

In today‘s era green buildings are essential as environmental balance is important for survival and further development of human beings, but first people have to be made aware not to see green buildings as an extra monetary burden. Green buildings are only way to a sustainable tomorrow.

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