

## ECO-FRIENDLY BUILDING CONSTRUCTION USING GREEN BUILDING CONCEPT

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**Abstract**— In India the environment of many of the city is very warm. Owing to the increasing population needs, the construction activity is at its boom, resulting in an increase in concrete structures and consequently decrease in green areas. The climate of the city is quiet warm during the months of summer with temperature reaching up to 48<sup>0</sup>C so proper care should be taken to avoid getting any kind of heat related alignment. Also the phenomenon of global warming or climate change has led to many environmental issues including higher atmospheric temperatures, intensive precipitation, and increased greenhouse gaseous emission resulting in increased indoor discomfort condition. Researchers worldwide collectively agreed that one way of reducing the impact of global warming is by implementing “Green Roof Technology” which integrates vegetation, growing medium and water proofing membrane on top of the roof surface.

It gives the effect of green plantation on inclined roof to the indoor temperature on any building in hot climate. The experiment showed a promising result where by the average indoor temperature dropped between 0.6<sup>0</sup>C to 2.7<sup>0</sup>C as recorded during the observation for bare roof, while average indoor surface temperatures dropped between 4.8<sup>0</sup>C to 6.9<sup>0</sup> C with green roof during daytime.

**KEYWORDS**— Green Building, Eco-friendly housing, Green roof Technology, environmental pollution, water harvesting system

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### I. INTRODUCTION

With the new technologies constantly being developed, the current practice to compliment this is to create greener structures, the common objective being the design of green buildings to reduce the overall impact of the built environment on human health and the natural environment by:

- Efficiently using energy, water, and other resources.
- Protecting occupant health and improving employee productivity.
- Reducing waste, pollution and environmental degradation.

Carbon dioxide (CO<sub>2</sub>) which is the principal greenhouse gas is said to be the foremost reason for this. With the increase in CO<sub>2</sub> in atmosphere, the ability of earth surface to reradiate heat to the atmosphere is reducing. Thus it acts like a blanket over the surface and keeps the earth warmer. The warmer envelope outside is having an immense effect on the indoor temperature of building. Mentioning the buildings and hu-man comfort level, with an increase in outdoor air temperature, buildings are experiencing indoor discomfort, thus increasing the demand for mechanical ventilation leading to higher energy consumption in buildings.

Apart from this the rapid urbanization process which is associated with the deterioration of green areas has created an unhealthy environment becoming a major contributor to climate change.

Environmental pollution is thus becoming common in urban areas due to increasing concrete structures as well as due to rapidly increasing population causing the reduction of green surfaces and resulting in many negative environmental impacts on the society.

The temperature in April–May sometimes rises even above 48 °C (118 °F), accompanied with hot dry winds. Thus taking into consideration the climate of different cities along with the prevailing environmental conditions the population is experiencing, the following approach was made, of making building green by using certain techniques to combat the extremities of the climate in that cities

#### **A. Necessity of Eco-friendly housing**

Sustainable buildings provide financial rewards for building owners, operators, and occupants. Sustainable buildings typically have lower annual costs for energy, water, maintenance/repair, and other operating expenses. These reduced costs do not have to come at the expense of higher first costs. Through integrated design and innovative use of eco-friendly materials and equipment, the first cost of a sustainable building can be the same as, or lower than, that of a traditional building. Some sustainable design features have higher first costs, but the payback period for the incremental investment often is short and the lifecycle cost typically lower than the cost of more traditional buildings. In addition to direct cost savings, eco-friendly buildings can provide indirect economic benefits to both the building owner and society. For instance, eco-friendly sustainable building features can promote better health, comfort, well-being, and productivity of building occupants, which can reduce levels of absenteeism and increase productivity. These features can offer owners economic benefits from lower risks, longer building lifetimes, improved ability to attract new employees, reduced expenses for dealing with complaints, less time and lower costs for project, resulting from community acceptance and support for sustainable projects, and increased asset value. Eco-friendly buildings also offer society as a whole, economic benefits such as reduced costs from air pollution damage and lower infrastructural costs, e.g., for avoided landfills, wastewater treatment plants, power plants, and transmission/distribution lines. The aim of this study is to know the importance and significance of the various factors, involved in construction of the eco-friendly housing, the requirements of which can be listed as below:-

1. To upgrade the construction of sustainable house.
2. To introduce roof gardening.
3. To upgrade the house in maintaining a good thermal comfort inside the building.
4. To demonstrate and popularize the technology of roof gardening and insulated cavity wall.
5. Use of energy efficient materials which consume less energy.

## **II. GREEN ROOF TECHNOLOGY**

One way of reducing the impact of global warming is by implementing Green Roof Technology where roof consists of vegetation and growing medium sometime referred to as Roof Garden. This have proved that green roof could give many environmental benefits to the buildings and occupants. A Green Roof is a roof of a building that is partially or completely covered with vegetation and a growing medium, planted over a waterproofing membrane. It also includes additional layers such as a root barrier and drainage and irrigation systems. Green roofs serve several purposes for a building, such as absorbing rainwater, providing insulation, and helping to lower urban air temperatures. There are two types of green roofs: 1) Intensive roofs, which are thicker and can support a wider variety of plants but are heavier and require more maintenance, and 2) Extensive roofs, which are lighter than an intensive green. The term "green roof" is generally used to represent an innovative yet established approach to urban design that uses living materials to make the urban environment more livable, efficient, and sustainable. Green Roof Technology (GRT) is the system that is used to implement green roofs on a building simultaneously dealing with

- Strength to bear the added weight.
- Seal the roof against penetration of water, water vapors, and roots.
- Retain enough moisture for the plants to survive periods of low precipitation, yet are capable of draining excess moisture when required.
- Provide soil-like substrata to support the plants.
- Maintain a sustainable plant cover, appropriate for the respective climatic region.
- Offer a number of hydrologic, atmospheric, thermal and social benefits for the building, people and the environment.
- Protect the underlying components against ultraviolet rays and thermal degradation.

#### **A. Advantages of Green Roof:-**

Roofs represent a large percentage of impervious surfaces; placing vegetation on them can substantially reduce storm water runoff.

- Green roofs can manage much or all of the runoff that would otherwise be generated by a building's roof area.
- Green roofs cover normal roofing materials, shielding them from wear and prolonging their life.
- Rooftop vegetation adds to the insulation of a building, reducing cooling and heating requirements.
- The collective effect of several buildings with green roofs can reduce the heat island effect of urban areas, improve the air quality, and reduce dust and other airborne particles.

Researchers have discovered that Green roof could potentially reduce energy usage, fossil fuel consumption and greenhouse gas emissions. On an average (5 to 7) °C reduction in indoor air temperatures were measured in building with green roofs during daytime hours and 0.3°C higher at night.

#### **B. Important Features of the Present Study**

The present study was executed with the following strategies as enumerated below showing their positive outcomes and observations:-

Phase I: Eco-friendly Wall Systems a Sustainable Design

Phase II: Inclined Green Roofs

Phase III: Water Harvesting System.

##### **Phase I: Eco-friendly Wall Systems: Sustainable Design.**

The main factor which highly affected the room temperature were the walls of the building as it is the wall which is in the direct contact with the surrounding environment and faces the variation of temperature due to climate change. By constructing an eco-friendly or insulated cavity wall using rat trap bond wall technique with the cavity in walls filled by wooden powder which provided thermal insulation helped to reduce the room temperature and provide cooling effect as well. Thus reduction in room temperature was achieved to a great extent.

Eco-friendly wall finishes included plaster finishes and paints that are friendly to the environment. These finishes and textures can make quite a statement or provide a subtle background. Many of these finishes will get better with age, all you need is a standard paint. These eco-friendly wall finishes were provided for all the external walls of the residence.

##### **Phase II: Inclined Green Roofs**

The Extensive green roofs, are light-weight with a very thin layer of soil using primarily drought resistant plant species such as sedums and mosses. These roofs survive on natural rainfall and do not need more maintenance than an annual check and a limited feed with nutrients. Green roofs having an inclination of (200 to 300) were used on top of the house. These actually can be found in many different shapes and sizes. Creating a green roof does many favours to the environment and the user as well. These roofs are attractive and can give urban dwellers a positive view and also an improved microclimate. There are also financial benefits to green roofs as the roofing material lasts longer and the cost of heating and cooling the building decreases.

### **Phase III: Water Harvesting System**

Rain water harvesting also implemented in order to make the project sustainable and eco-friendly. A storage area was made near the house for storage of water. Provision was made to recycle the treated grey water for watering the plants.



**Figure 1: Model of Green Roof House**

### **III. OBSERVATIONS AND ANALYSIS**

In the project discussed here a house which was constructed with conventional methods and another experimental house having green roof and eco-friendly technologies constructed the temperature observations are taken on both the houses and following are the observation found. At the time of experiment the following observation were taken on the traditional and green building:-

Normal Temperature Outside = 32.00C

Room Temperature of Traditional Building = 31.40C

Room Temperature of Green Building = 29.30C

Reduction in Temperature for Traditional Building = 0.60C

For Green Building = 2.70C

Difference between Reductions in Temperature of Traditional and Green Building = 2.10C

After the increase in temperature by the lighting effect Temperature outside around Traditional and Green Building= 37.00C

Room Temperature of Traditional Building = 34.90C

Room Temperature of Green Building = 30.10C

Reduction in temperature For Traditional Building = 2.10C

For Green Building = 6.90C

Difference between Reductions in temperature of Traditional and Green Building = 4.80C

Therefore the result shown above indicate that a Green building will have reduced room temperature and provide more cooling effect as compared to the traditional building.

Thus the above readings green house has a reduced indoor temperature as compared to the house constructed by the conventional method.

#### **IV. CONCLUSION**

We are living at a time when the earth is constantly being subjected to UV rays, global warming, and high level of pollution. The disaster is the unhealthy condition in our living. The environment of many cities in India is also very hot in summer due to the major problem of global warming, greenhouse effect and uncertainty in climatic behavior which is affecting the human beings vastly. So this green building approach will prove to be very beneficial giving effective result to reduce the extreme heat during the summer thus reducing energy consumption making the building sustainable providing the comfort level for the residents A green building with water harvesting system utilize the natural energy to reduce temperature and increase ground water level hence it saves the additional cost required for mechanical means to reduce temperature.

Its advantage can be summarized as stated below:

1. It will absorb CO<sub>2</sub> from atmosphere and reduces the greenhouse effect.
2. The plantation will also give pleasant look to the building and surrounding areas.
3. The collective effective of several buildings with green roof can reduce the —Heat island effect in urban areas, improve the air quality and reduce the dust and other airborne particles.
4. By providing green roofs, insulated cavity walls and tiles on the outer face of the wall, reduce the indoor temperature about 50C to 70C.
5. The rain water harvesting system will increase the ground water level which will be utilized in the period of demand. A green building with water harvesting system utilize the natural energy to reduce temperature and increase ground water level hence it will save the additional cost required for mechanical means to reduce temperature.

Though the concept of Green Homes in India is new, yet it will help us to put the first step forward in preservation of the earth's natural resources and cutting down on energy consumption and its cost.

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