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# Conversion of Existing Room into Green Room

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***Abstract: Humans are most exposed to indoor air. Half of the body's lifetime intake is house air. Indoor air exposure causes most environmental diseases. Today's environmental challenges are outdoor air quality, energy utilisation, and not duplicate (IAQ). But evidence is accumulating that IAQ causes morbidity and mortality. Creating Indoor unvented biomass cooking causes at least 2,000,000 (mostly women and children) die each year in wealthy countries. IAQ causes allergies, hypersensitivity responses, and airway inflammation, cancers, infections Radon and ETS (Environmental Tobacco Smoking) cause lung cancer, Sick Building Syndrome, inadequate ventilation. Future IAQ and health issues must be prioritised.***

***This project also aims towards a quick composting endeavour to convert kitchen wet waste to compost in as little as 25 to 35 days. Vegetable cuttings, dry and wet leaf twigs, grass clippings, tree trimmings, and other wastes are included in the composting process. Composting comes into play here; organic waste may be recycled and the resulting product can be utilised to improve soil quality and aid plant growth. This can be simply implemented at hotels, colonies, schools, and institutions with readily available wet waste. The compost that is produced is used as manure for plants on the campus of the college.***

***Keywords: Indoor Air Quality (IAQ), Health, Allergy, Indoor environments, Dampness, Ventilation, Kitchen Wet Waste, Composter.***

## I. INTRODUCTION

Green building is a tried-and-true, practical, and intuitive method of constructing ecologically friendly structures. Green building structures are energy efficient, save resources, create healthier interior conditions, and provide long-lasting and attractive places made from ecologically friendly materials. Integrated design concepts, solar orientation, appropriate footprint sizing, glazing awareness, material durability, economic life-cycle analysis, material reuse and salvage, natural material content, locally available materials, and economic sustainability are all part of the green building process. This project attempts to make an existing room more environmentally friendly, durable, and renewable. The goal of this project is to transform an existing room into a green room utilising Indian Green Building Council-approved procedures (IGBC). We used paints with minimal volatile organic compounds (VOCs) (should be less than 5 mg/l) and diverse indoor plants to keep the levels of oxygen and carbon dioxide in check. We implemented an automation technique in the same room in order to save electricity. We created a smart Wet Waste Composter for our college campus to obtain the best wet waste management system possible. Our college canteen's wet waste (kitchen garbage) will be turned into clever organic manure. The manure produced by the Wet Waste Composter can be utilised as fertiliser in the garden.

## II. LITERATURE REVIEW

### A. *Greening Existing Buildings [GEB] strategies - Ben Chak-Man Leung (2018).* **[1]**

This article outlines a systematic approach to greening existing buildings [GEB]. The study concluded that employing the following GEB techniques can save 40–60% of energy. This considerable energy savings will contribute to a 20-30% reduction in carbon intensity. A case study revealed that using the GAA evaluation scheme and GEB tactics to green an existing building is practical and cost-effective. The suggested monies to be subsidised for both greening and upkeep of existing buildings with ages 40 years are justifiable for GEB promotion.

### B. *Analysis on Green and Sustainable Building Techniques - Chandra Shekhar Singh (2018)* **[2]**

The paper presents a tiny concept to save the environment and energy: Green Building Design Enviro-friendly design will be a huge step forward for the building industry. Choosing eco-friendly sustainable building materials may be the fastest approach for builders to start integrating sustainable design concepts in structures. Thus, choosing construction materials with little environmental impact is beneficial to a nation's long-term development. The goal of this study is to show how sustainable building materials can help reduce environmental degradation and create healthy buildings that benefit both occupants and the environment.

*C. Innovations in Transforming a Traditional Building into Green Building- A. Kodnikar, Sneha Hajare (2018).* **[3]**

This paper describes how to convert an existing structure into a green building that saves water, energy, and materials. Water is also conserved, recycled, and reused in eco-friendly ways.

Knowledge and diligence drive the implementation of green measures in existing buildings. Unlike new construction, upgrading existing buildings to green buildings needs constant monitoring of building systems, personnel training, and certification requirements.

*D. Comparative Study of Conventional and Green Residential Building - Gayathri P., Vishnu N. (2017).* **[4]**

This study emphasised, Reduced the use of other fossil fuels by producing biowaste that can be converted to biogas. Greywater treatment for gardening, flushing, etc.

To reduce water scarcity during the dry season. An efficient cooling system that works like an electric air conditioner. The passive design improves indoor circulation and lighting. Solar panels help generate electricity for domestic use. Energy-2D simulation programme represents thermal variation. A model of the whole green building was constructed. The selected residential building's LEED point improved following conversion.

*E. Green Buildings and Sustainable Construction -Mr. Prithviraj Dilip Mane (2017).* **[5]**

Independent Biomass Systems on College Campuses: A Cost-Benefit Analysis Hostel food waste and other biomass leftovers can be better utilised on college campuses. To strengthen the industry's acceptance and momentum of sustainable practises, developers at all levels should be educated.

*F. Energy and Sustainable Strategies in the Renovation of Existing Buildings- Mariona Rotilio (2017).* **[6]**

The research demonstrated the value of combining material, cultural, and historical investigations to characterise a structure and its features. The review focused on two themes: adaptive re-use of a significant historical structure in the urban core, and the use of sustainable solutions when renovating the building shell and systems.

*G. Sustainable Material for Green Building Construction – Usman Umar, Dr. Mohd. Khalidi (2017).* **[7]**

The goal of this study is to show how sustainable building materials can help reduce environmental degradation and create healthy buildings that benefit both occupants and the environment. Materials are vital in building construction. Building materials are usually chosen based on their utility, technicality, and cost.

*H. Hybrid Solar & Kitchen waste based Plant for Green Buildings – G.R.K.D. Satya Prasad, Dr. K. Vijaya Kumar Reddy, Dr. Ch. Saibabu (2015).* **[8]**

This study describes a systematic method to zero energy buildings using canteen food waste to create power and solar power to integrate. Using Homer software simulation, this paper illustrates the economics of Solar-Biomass hybrid systems. Kitchen food waste from hostels and restaurants can be utilised to generate power when combined with solar power. Using these two resources efficiently can reduce solar power unit costs and increase system reliability.

*I. Green Quotient Evaluation of Existing Buildings: A Case Study – S. Bansal, S.K. Singh, S. Biswas (2015).* **[9]**

The goal of adopting the integrated, whole-building design process should be to construct a high-performance building, not just save energy. It is now mandatory to not only create green but also rate existing buildings' Green Quotients according to LEED-EB. Existing structures in Delhi-NCR consume a lot of electricity and water, significantly impacting the environment. The International Energy Agency calculated that existing buildings account for almost 40% of worldwide primary energy use and 24% of global CO2 emissions.

*J. The Economics of Green Building - Piet Eichholtz, Nils Kok, and John M. Quigley (2013).* **[10]**

The study looked at a wide range of office buildings and found that energy-efficient buildings pay for themselves quickly. In addition to thermal efficiency, the features graded for sustainability contribute to green building premiums in rents and asset values. The features valued for thermal efficiency, as well as sustainability, lead to premiums in rentals and asset values. Increased energy efficiency increases rents and asset values in green buildings.

*K. Construction of an Eco-Friendly Building using Green Building Approach – Ashish Kumar Parashar, Rinku Parashar (2012). [11]*

The current study places an emphasis on the utilisation of the Rat trap bond wall technique with insulated cavity walls and rooms with an inclined roof approach that has a green cover for a residential construction. The cavity in the wall was filled with hardwood powder to act as an insulating substance, and the outer surface of the wall was covered with tile to protect it from temperature and wetness.

*L. Early design simulation tools for net-zero energy buildings- Shady G. Attia and André De Herde (2011).* **[12]**

This paper defined the tools' possible use by architects for designing NZEBs. Criteria for NZEB tools were designed to examine existing BPS tools. To compare simulation tools and their appropriateness for NZEB design. One tool that was tested was Solar Shoebox from Open Studio Plug-in. Others were Design Builder from ECOTECT and BE.opt. The comparison uses two sets of criteria. Limitations of tools and important NZEB requirements are described.

## III. METHODOLOGY

*A. Indoor Air Quality*

We have selected Tutorial Room of Civil Engineering Department for achieving Indoor Environment Quality. To implement that we applied Low VOC (Volatile Organic Compound) paint on interior walls of room as suggested by Indian Green Building Council (IGBC) as well as for improving Air Quality inside the room we have installed many Indoor Plants which will help to increase level of Oxygen and will effectively reduce the level of Carbon Dioxide inside the room.

1) *Volatile Organic Compound-* Organic substances with a high vapour pressure at room temperature are known as volatile organic compounds. VOCs, or volatile organic compounds, are gases released into the atmosphere by products or processes. A low boiling point is associated with a high vapour pressure, which is related to the amount of molecules in the surrounding air, a property known as volatility. Some are dangerous on their own, such as those that cause cancer. Furthermore, once in the air, they can react with other gases to produce further pollutants. So we have selected a paint which doesn't emit Volatile Organic Compounds.

We chose the Nerolac Impression Ultra HD for our project since it met all of the Indian Green Building Council's requirements (IGBC). Such as,

*a)* Ultra Low VOC
*b)* Ultra Low Odour
*c)* Excellent Antifungal
*d)* Radiant Sheen


Fig: Nerolac Impression

Fig: Before painting

Fig: After painting

2) *Indoor Plants*- Indoor plants assist to remove common toxins and pollutants from the air, such as formaldehyde and benzene. Plants can be a source of pleasure in your home or office. Stress is relieved, creativity, productivity, and focus are increased, and healing is aided by indoor plants. Indoor plants may also improve the air quality in your house.

Some of the plants we chose are,

a) *Snake Plant* – It can absorb cancer-causing chemicals such as CO2, benzene, formaldehyde, xylene, trichloroethylene, and toluene, even at night. When employed in schools and colleges, indoor plants can also help with mental health.
b) *Red Dracaena*- The red dracaena (Dracaena Marginata), also known as dragon tree plants, is distinguished by its vibrant red colour, which ranges from pink to deep red. Some kinds have a crimson leaf edge, while others have completely red leaves.
c) *Money Plants*- Money plants are said to be natural air purifiers. One of the best advantages of having a money plant in your home is that it keeps it clean and fresh. Carbon monoxide, xylene, benzene, and toluene are among the dangerous chemicals removed from the air. It also removes pollutants and hazardous compounds from the air.
d) *Areca Palm Tree*- Acetone, Xylene, Toluene, and Formaldehyde, which are emitted by petroleum goods, paints, and wooden furniture, are absorbed by Areca Palm plants. Petroleum products, nail polish, paints, detergents, adhesives, and cleansers, among other things, are a major source of Acetone indoors.

Fig. Snake Plant

Fig. Red Dracaena

Fig. Money Plant

Fig. Areca Palm Tree

*B. Automation*

Electricity waste has been a huge worry for every one for decades, and it needs to be handled with new technology like Automation. Building energy efficiency is crucial, and one of the goals of a smart building is to minimize, and control building energy usage while maintaining occupant comfort and operating efficiency. For our project we used sensors like 'Light Detecting Sensor' and 'Motion Sensor'.

1) *Light Sensor:* The light sensor is a passive device that converts the light energy into an electrical signal output. Light sensors are more commonly known as Photoelectric Devices or Photo Sensors because they convert light energy into electronic signal.
2) *Passive Infrared Sensor*: Passive infrared (PIR) sensors use a pair of pyroelectric sensors to detect heat energy in the surrounding environment. Operation of these sensors are based on radiation emitted from human which we can't see. PIR sensors are used in thermal sensing applications like motion detection.

Fig: LDR Light Sensor Module

Fig: Motion Sensor

In order to reduce our carbon footprint and save money on electricity, we automated certain processes. Light Sensor Module and Motion Sensor are the two varieties of sensors that have been utilised in the process of automating. The on/off mechanism of any tubelights or bulbs in the room can be controlled with the help of a light sensor module. On the other hand, the motion sensor monitors the activity within the room and relays that information to the light signal module.

### C. *Wet Waste Composter*

Increased trash output, either wet waste or dry waste, has resulted from rising rates of population expansion and industrial development, particularly in urban areas. Realizing a sustainable wet waste management system has proven difficult, particularly in many wealthy countries. Organic garbage makes up a large amount of municipal solid trash in many nations. Around half of it can be composted, according to estimates. Instead, the majority of it is filled with land and burned. We can save resources and develop a useful by-product that can be used as locally generated fertiliser by composting organic waste.

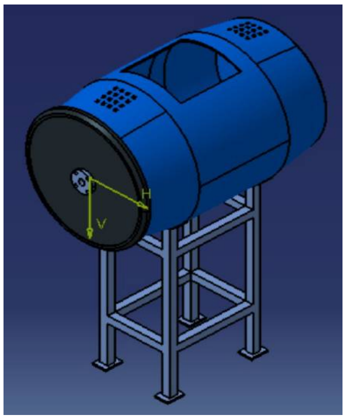


Fig: Wet Waste Composter

*Construction*- We designed Wet Waste Composter for our college canteen wet trash (i.e., kitchen waste). We chose a tumbler with a capacity of 150 litres (approx. 150 kg) based on the information we gathered and the garbage created by the canteen. After that, we added a shaft for mixing and blending. We've installed a set of sharped blades in a staggered design to evenly blend the waste. The offered shaft will be manipulated manually with the use of a handle, and bearings will be provided at the shaft's ends to ensure smooth operation. We give air passage on the upper surface to speed up the composting process, which is our goal. The advantage of the chosen tumbler is that its slope and curve design make it easy to collect the leachate generated in the composter during the operation. We provide a hole in the centre of the bottom curving surface of the tumbler with a valve to collect the leachate. With the configuration of a hook lock, we create an entrance on the upper surface to insert the waste into the tumbler as well as to collect the manure at the end of the process from the tumbler. Finally, the tumbler was placed on a metal stand.

Our composter is distinctive in that it can be dismantled quickly for transportation and cleaning. To improve the composting process, we can use activators or Compost Accelerators, which will help compost the waste in the shortest amount of time possible. One of the disadvantages of a wet waste composter is that it might contribute to odour pollution on college campus; however, we can address this by using Odour Remover powder in the composter. We can also organise a number of composters in tandem in a single steel/metal rack to boost efficiency while saving money.

## IV. RESULTS AND ANALYSIS

Before and after the implementation of the project, we tested the indoor air quality in the project room where we were working. The following are the various readings that we obtained:

Table 1: Results before implementation of IEQ improving techniques

| Sr. No. | Location | $O_2$ | $CO_2$ | $SO_x$ | $NO_x$ | CO | $NH_3$ | HCHO | AQI | TVOC | PM2.5 | PM10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Acceptable Limit ⇨ | More than 18 (%) | Less than 0.3 (%) | Less than 20 (µg/m$^3$) | Less than 30 (µg/m$^3$) | Less than 4 (mg/m$^3$) | Less than 100 (µg/m$^3$) | (Formaldehyde) Not Specified (µg/m$^3$) | Less than 150 | Less than 0.5 (µg/m$^3$) | Less than 40 (µg/m$^3$) | Less than 60 (µg/m$^3$) |
| 1 | Location 1 | 20.9 | 0.2 | 5 | 2 | 0 | 5 | 0.13 | **152** | 0.59 | **57.5** | **98** |
| 2 | Location 2 | 20.9 | 0.2 | 6 | 4 | 0 | 5 | 0.39 | 144 | **1.26** | **54.2** | **90.1** |
| 3 | Location 3 | 20.9 | 0.2 | 4 | 3 | 0 | 6 | 0.13 | 139 | 0.58 | **50.4** | **84.6** |

1) *Remarks:* Before starting the project, we tested the indoor air quality in three separate locations in room. Table 1 shows the respective results. The results show that the levels of oxygen, carbon and sulphur oxides, carbon monoxide, and ammonia are all below the permissible limit. However, the Air Quality Index was not good, and the total volatile organic compounds (TVOC) level was also higher than the permissible threshold. Particulate Matter (PM) readings are also unsatisfactory because they increase indoor pollution.

Table 2: Results after implementation of IEQ improving techniques

| Sr. No. | Location | $O_2$ | $CO_2$ | $SO_x$ | $NO_x$ | CO | $NH_3$ | HCHO | AQI | TVOC | PM2.5 | PM10 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Acceptable Limit ⇨ | More than 18 (%) | Less than 0.3 (%) | Less than 20 (μg/m$^3$) | Less than 30 (μg/m$^3$) | Less than 4 (mg/m$^3$) | Less than 100 (μg/m$^3$) | (Formaldehyde) Not Specified (μg/m$^3$) | Less than 150 | Less than 0.5 (μg/m$^3$) | Less than 40 (μg/m$^3$) | Less than 60 (μg/m$^3$) |
| 1 | Location 1 | 27.4 | 0.1 | 5 | 2 | 0 | 5 | 0.13 | 130 | 0.30 | 36.4 | 65 |
| 2 | Location 2 | 27.3 | 0.1 | 6 | 4 | 0 | 5 | 0.39 | 124 | 0.40 | 38.1 | 58.3 |
| 3 | Location 3 | 27.5 | 0.1 | 4 | 3 | 0 | 6 | 0.13 | 120 | 0.44 | 35.2 | 60.1 |

2) *Remarks:* We did another Indoor Air Quality test in the same room after using air quality improvement measures. The results were excellent and much below the allowable limit. Because of the appropriate planting of indoor plants, the oxygen level was enhanced even more. The Air Quality Index was likewise good, falling below 150. We acquired low levels of VOC compounds as a result of painting inside walls with low VOC paints. On the other hand, we attempted to keep particulate matter levels below the threshold.

## V. CONCLUSION

1) The indoor air quality of the specified space is enhanced in accordance with Indian Green Building Council rules (IGBC).
2) Provided a superior alternative to conventional wet waste composting techniques.

## VI. ACKNOWLEDGMENT

It gives us immense pleasure to present this project report on the **"Conversion of Existing Room into Green Room".**

We would like to convey our heartfelt gratitude to **Prof. Akshay B. Rahane**, our project guide, who provided invaluable advice and assistance at every stage of the project's development. I'd want to use this opportunity to express my gratitude to our principal, **Dr. H. U. Tiwari**, and **Prof. Sudarshan S. Bobade** (Head of Civil Department), for opening the doors of the department towards the realization of our project, for their guidance and encouragement. **Prof. Satish A. Pitake**, our coordinator, deserves special thanks for providing us the additional motivation to try something new.

We also want to thank every one of our family and friends for their support, without which we would be unable to accomplish our project work. I'd want to take this opportunity to thank everyone who assisted us, as well as all those unseen people across the internet who helped us maintain those vital resources for the successful completion of our project. All of them are responsible for our achievement.

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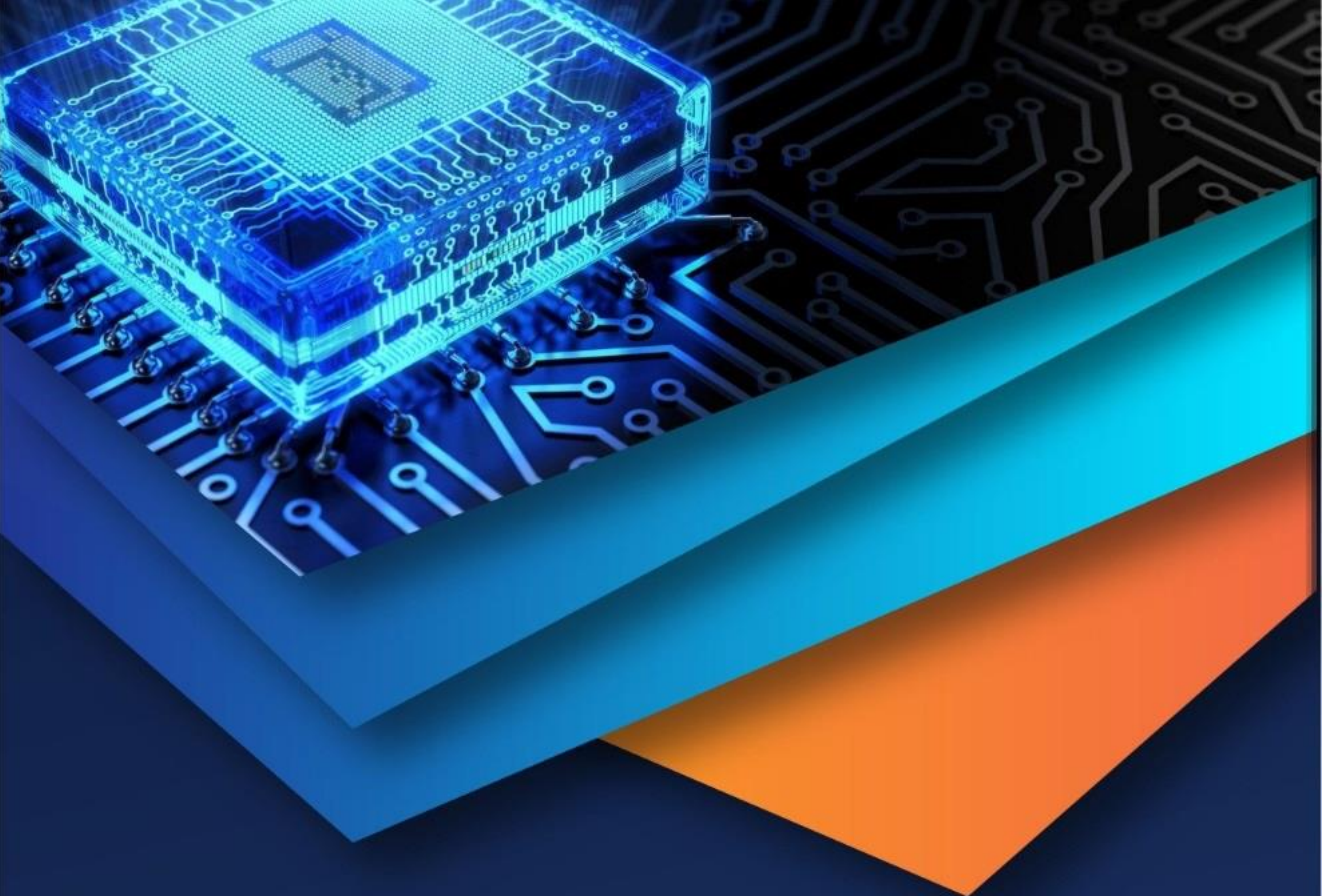


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