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A lead towards Green Energy Building: A futuristic Approach

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ABSTRACT: Green building design keeps check on full life cycle impacts of the resources that make up the structure. Bio Climatic Design takes into account local climate and environmental conditions to help achieve thermal and visual comfort inside and make the best possible use of solar or wind energy [1]. Focus is given on the renewable resources right from the beginning [2]. Use of sunlight through solar panels and photovoltaic cells is encouraged. Optimized use of green roof and rain gardens to reduce rainwater run-off. Use of packed gravel instead of asphalt or concrete to enhance replenishment of ground water[2]. Use of high-efficiency windows and insulation in walls, ceilings and floors. Use of trees in front of windows to produce shade in the summer and maximize solar rays during winter [4].

KEYWORDS: Bio Climatic Design, Renewable Resources, Solar Panels, Photovoltaic Cells, Rainwater Run-off, Packed Gravel, Asphalt.

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I. INTRODUCTION

The Fast increasing world energy consumption levels have already raised concerns over the excessive usage of resources and subsequent environmental impacts [1]. The international energy agency has shown frightening information on energy consumption trends across the Globe [8]. According to WEO (2009),

energy is accounting for 65% of the World's Green house gas (GHG) emissions [2]. Being a developing country, power consumption has been increasing at greater pace in India. Energy consumption growth rate in commercial buildings (8%) is more than that of Residential sector (5%) and Floor area increase itself is expected to grow from 659 million Sq. Mts in 2010 to 1900 million Sq.Mts in 2030[2].

Construction industry has a very important role in on Indian economy, contributing on an average 6.5% of the GDP [5]. At the same time, it has lot of impact on the environment with its consumption of energy both operational energy and embodied energy in the materials that it uses. Commercial Building space accounts for 33% of the total built space and increasing at a rate of 8-10% annually [2]. The average annual electricity consumption for space conditioning and lighting in India is around 80 KWh/m2 and 160 KWh/m2 for residential and commercial buildings respectively[8]. At this juncture it is very important to understand the pattern of energy consumption in building sector so as to take up energy conserving measures for the same

II. EXISTING METHODOLOGY

Commercial Building space accounts for 33% of the total built space and increasing at a rate of 8-10% annually. The average annual electricity consumption for space conditioning and lighting in India is around 80 KWh/m2 and 160 KWh/m2 for residential and commercial buildings respectively. Lighting is the largest end use of electricity in commercial buildings, and many buildings target lighting for energy savings through energy-efficient light sources and advanced lighting technologies [4]. Electricity and natural gas are the most common energy sources used in commercial buildings. District energy systems generally use fossil fuels (coal, natural gas, or fuel oil), although some use renewable sources of energy (biomass, geothermal, solar, and wind energy) [8].

We see that usually the chemical energy stored in fossil fuels is converted to usable forms of energy via heat by burning, with an efficiency of about 90%. Heat engines have a conversion efficiency of up to 60%. The vast majority of the current cars and trucks works on this principle. Mechanical energy can be converted into electricity using electric generators with an efficiency of 90% or even higher. Most of the World's electricity is generated with turbogenerators that are connected to a steam turbine, where coal is the major energy source. Chemical energy can be directly converted into electricity using a fuel cell. The most common fuel used in fuel cell technology is hydrogen. Typical conversion efficiencies of fuel cells are 60% [2]. A regenerative fuel cell can operate in both directions and also convert electrical energy into chemical energy. Such an operation is called electrolysis; typical conversion efficiencies for hydrogen electrolysis of 50-80% have been reported. In nuclear power plants, energy is released as heat during nuclear fission reactions. With the heat steam is generated that drives a steam turbine and subsequently an electric generator just as in most fossil fuel power plants [2].

III. PROPOSED METHODOLOGY

Buildings consume energy both directly or indirectly in all phases of their life. [1] The energy consumed by the building is broadly classified into two types, Embodied energy and Operating energy[16]. The energy utilized during manufacturing phase of the building is called the Embodied energy. It includes the energy content of all the materials used in the building and technical installations, and energy incurred at the time of erection/construction and renovation of the building. Operating energy is the energy required for maintaining comfort conditions and everyday maintenance of the buildings. It also includes the energy for HVAC (heating, ventilation and air conditioning), domestic hot water, lighting, and for running appliances. It largely varies on the level of comfort required, climatic conditions and operating schedules.

Integrating Embodied Carbon Feedback in Early-Stage Design

It is impractical to reduce the Embodied Carbon of a building once it is built, so it is necessary to strategize and optimize during the design and construction phases [5]. It is necessary to assess the opportunities and risks of material innovation in a developing construction industry. Planning of low carbon footprints, assurance of the low embodied carbon build with local, sustainable materials are to be considered. Other aspects are as rethinking of Building Elements, Large-Scale additive Manufacturing, A Brave New Hub for building material reuse where recycling gets a lot of attention, but reuse is just an important, and consumes significantly less energy. The circular economy When a building reaches the end of its life, many building materials can be recycled, remaining others be directly reused in new projects, achieving maximum reduction in embodied carbon [4].

Guidelines for reducing Embodied Energy

- Lightweight building construction such as timber frame is usually lower in Embodied Energy than heavyweight construction, where a lightweight building is the most appropriate and may result in the lowest life cycle energy use, e.g. hot, humid climates; sloping or shaded sites; sensitive landscapes.
- In climates with greater heating and cooling requirements and significant day-night temperature variations, embodied energy in a high level of well-insulated thermal mass can significantly offset the energy used for heating and cooling [1].
- There is little benefit in building a house with high embodied energy in the thermal mass or other elements of the envelope in areas where heating and cooling requirements are minimal or where other passive design principles are not applied.
- Each design should select the best combination the application based on climate, transport distances, availability of materials and budget, balanced against known embodied energy contents [2].

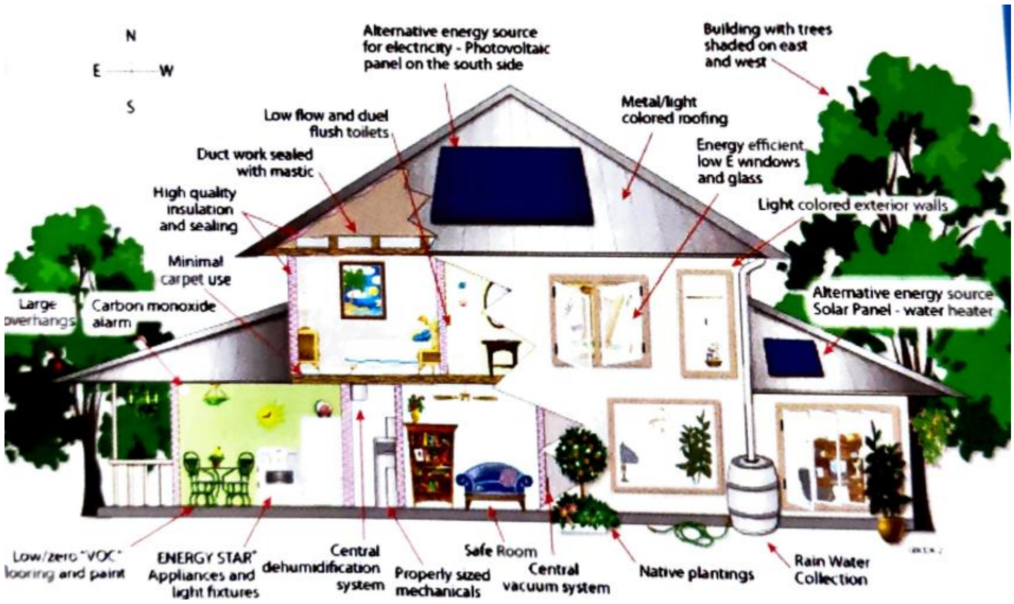
Design for Long Life and Adaptability, Using Durable Low Maintenance

- Ensure materials can be easily separated.
- Avoid bigger building than needed, and save materials.
- Modify or refurbish instead of demolishing or adding.
- Ensure construction wastes, and materials from demolition of existing buildings are reused or recycled.
- Use locally sourced materials (including materials salvaged on site) to reduce transport.
- Select low embodied energy materials (which may include materials with a high recycled content), preferably based on supplier-specific data.
- Avoid wasteful material use specify standard sizes wherever possible windows, door and panels to avoid using additional materials as fillers. Minimise energy intensive finishes, such as paints [5].
- Ensure offcuts are recycled and use only sufficient structural materials to ensure stability and meet construction standards.
- Select materials that can be reused or recycled.
- Give preference to materials using renewable energy sources.
- Use efficient building envelope design and fittings to minimize materials, an energy efficient building envelope can downsize or eliminate the

need for heaters and coolers, water-efficient taps can allow downsizing of water pipes [4].

- Get information about their products and share this information.

Green Construction - Material Selection [7]



Green Building Material

Selecting what materials to use is usually part of the designing stage as well to ensure sustainability in the following years, such as [4]:

- Rapidly renewable plant materials such as Bamboo and straw.
- Lumber from forests certified to be sustainably manage.
- Dimension stone, a natural stone or rock that has been selected and fabricated.
- Recycled stone and metal and other products that are nontoxic, reusable, renewable, and/ or recyclable.
- Use building materials from local Sources to minimize energy use due to their transportation [1].
- Along with materials, sustainability in the construction, process can also include acts

- such as employing local, so that opportunities and greater wellbeing are fostered in the local community [5].

Sustainable Building Materials

- Reclaimed wood, reclaimed metal
- Precast concrete
- Bamboo
- Cork
- Shipping Container
- Rammed earth tiles
- Earth Bags
- Recycled steel
- Ferrock
- Timber Crete, Grass Crete, Paper, Crete, Hemp Crete
- Sheep's wool
- Plant based Polyurethane Rigid Foam
- Straw cable
- Recycled plastic.

IV. PROPOSED EXPERIMENTAL WORK

Ferrock- Alternative Cement from Waste

- Approximately 95 per cent of Ferrock is made from recycled materials such as waste steel, dust and silica from the ground up glass.
- The steel dust, upon reaction with Carbon Dioxide (CO_2), produces iron carbonate, which when solidifies turns into solid rock known as Ferrock. One of the unique qualities of Ferrock is that it absorbs more CO_2 (a highly toxic gas) than it creates, unlike cement. Ferrock is five times stronger than the typical Portland cement.
- Timber Crete: A blend of sawmill waste, cement, sand, binders and non-toxic deflocculating additive, which is cured using the renewable resources of sun and wind into a unique building block [7].

- Glass-Crete: Glass-Crete specially designed for the toughest construction clean-up projects, removes concrete, mortar and other cement-type materials from architectural tempered and plate glass surfaces.

Plastic Wastes are Ideal Building Materials
- Plastics are strong, durable waterproof, lightweight, easy to mould , and recyclable.
- All polymers are, technologically100% recyclable. Some of them have the perfect cradle-lifecycle: they can be used again and again to produce the same goods.
- Some plastics can be reused just as they are by shredding an object into flakes, melting it, and reusing. Such recycled plastics may have lower mechanical properties compared to virgin plastics.
- Examples of successful industrial recycling include PET, or poly ethylene terephthalate, which is used to make soft bottles, and polystyrene.

Waste Reduction or Recycling [5]
- Waste can be reduced on several levels by taking a green approach. In terms of construction, using the materials listed earlier helps and divert waste from landfills. With the appropriate green-building measures, Waste reduction carries on to the operation of a building as well. Waste Recycling, including Waste Water Recycling is an area the scope for conservation is quite high.
- On site waste management, such as separating garbage, recycling and compost.
- Centralized wastewater treatment systems for reusing wastewater systems for reusing wastewater from dishwashing or washing machines.
- However, these are costly and use a lot of energy there are many smaller steps to be taken as an alternative, such as low power showerheads, converting wastewater to fertilizer via a biogas plant, and more, making it easy for occupants to reduce energy waste as a part of their daily routines, such as intelligent building design to allow them enough light that daytime lights are unnecessary, to mention one option.

Rain Water Harvesting
- Rainwater from the roof and rear terrace is filtered and let into the well to replenish the underground water table, this water is also treated [1].
- Turbidity is removed with pressures and filer. Iron is removed with an iron removal filter. Odour, however is taken care of by an activated carbon filter [5].
- In many cities, the public water supply cannot always be trusted. So, we need other sources.

Maintenance of Green Buildings
Maintaining a building is important to ensure it remains sustainable and profitable.
- As the building ages, it is important to check areas of the building to make sure they are still at an acceptable quality level.
- Low maintenance costs, taking into account the increased usage of natural light and temperature control services, the more natural used, less dependency on air conditioners, and lighting system.
- Smaller Scale maintenance, such as cleaning the building, improving indoor air quality, reducing water pollution, and maintaining environmentally sustainable concepts [4].

Operational Cost of a Green Building
Lower energy costs from some of the design aspects such as:
- High efficiency windows and insulation.
- Cool Roofs' that create high, solar reflectance, reducing heat transfer to the building, and high thermal remittance, when a large percentage of absorbed/non reflected solar energy is able to be released.
- These designs/efficient materials reduce costs directly in maximizing natural light, heating and cooling, thereby requiring less electricity usage [1].
- Capitalized natural ventilation.
- Heat recovery ventilation systems to recover heat from used air and transfer it to fresh air.
- Install fluorescent/ LED to use 2/3 to 3/4 less energy than incandescent bulbs, lowering electricity use with cooling loads[2].
- Installing highly efficiency appliances, Low flow toilets reduce energy directly by their efficiency and producing less waste heat.

V. CONCLUSION

The goal of green building is to increase the efficiency of resource use (including energy, water and materials) and reduce the building's negative impacts on the environment during the building's lifecycle[1]. Generating energy that produces no greenhouse gas emissions from fossil fuels and reduces some types of air pollution. This is an alternate approach to diversify energy supply and reducing dependence on imported fuels. It creates economic development and jobs in manufacturing, installation, and more. The most important aspect of clean energy are the environmental benefits as part of a global energy future.While clean, renewable resour ces also preserve the world's natural resources, they also reduce the risk of environmental disasters, such as fuel spills or the problems associated with natural gas leaks. The bioenergy feedstock and the way it is harvested can negatively impact land use along with global warming emissions [4]. For example, human and animal waste used to power engines may cut down on carbon emissions, but increase harmful methane emission [7].

"Zero energy" buildings achieve one key green building goal of reducing energy use and greenhouse gas emissions. Health benefits from green building of these Energy are greater than just a better natural feeling. Indoor air pollution lies among top five environmental risks [1]. Unhealthy air is found in up to 30% of new and renovated buildings [16].W.H.O. reports that indoor air pollution causes 14 times more deaths than outdoor air pollution (2.8 million lives) of hundreds of EPA-regulated chemicals [2], only ozone and sulphur dioxide are more prevalent outdoor than indoors. Most of our dwellings have too much lead dust or chippings, causes of kidney and red blood cell damage impairs mental and physical development, may increase high blood pressure.

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