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Comparative Analysis of a Conventional and a Green Sustainable Office Building – A critical Review

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Abstract:

This paper carries out a detailed comparison between a sustainable office building and a conventional one. Since, Buildings are very energy intensive and contribute largely to the ongoing climate crisis, it is necessary to construct them in an eco-friendly and sustainable manner. The financial, environmental and other benefits of such a building over a conventional one isn't very clear. This paper concludes by giving point to point comparison for a clearer understanding. The findings of this article can be helpful to green building planners, designers, and developers.

Keywords: Green Building, Sustainable Offices, Energy Efficiency, Rating systems, Cost comparison, Composite Materials.

Introduction:

Being the largest primary energy consumers, buildings are one of the world's largest contributors to the growing energy crisis and to global warming. World studies have acknowledged, buildings were attributable for 7.85Gt, or 33% of all energy-related CO2 emissions worldwide and these emissions are expected to grow to 11Gt by 2030[1]. The property sector's impact on the environment is not limited to carbon emissions and energy, with buildings in the European Union consuming 16% of potable water, 50% of raw materials and accounting for 40% of solid landfill waste.[2]

With the recent IT boom in Bangalore and India in general, there has been a surge of Office buildings in the form of IT tech parks that are very energy intensive and tend to have a large carbon footprint. Therefore, construction of sustainable buildings and creating a green work environment is the need of the hour.

The Green Building movement in India started gaining momentum in 2003, from just about 20,000 sq. ft in 2003 to 450 crores sq. ft green footprint in India today.[3] The practice of green building design and the use of green rating systems aim to minimise the demand on non-renewable resources; maximise the utilisation efficiency of these resources when in use; and maximise the reuse, recycling, and utilisation of renewable resources.[4]

Our project aims to shed light on the heavy (over 50%) saving potential in the building sector, the various aspects of a green office building while making a comparative analysis between a sustainable and a conventional model of an office building.

The result will be a simplistic point to point comparison which will help gauge the potential benefits of a sustainable workspace over a conventional one.

Green building

Green building (also known as green construction or sustainable building) refers to a structure and using process that is environmentally responsible and resource-efficient throughout a building's life-cycle: from sitting to design, construction, operation, maintenance, renovation, and demolition. This requires close cooperation of the design team, the architects, the engineers, and the client at all project stages. The green building practice expands and complements the classical building design concerns of economy, utility, durability, and comfort.[1]

The green building movement has overcome formidable, technical, and economic hurdles in recent years, yet adoption of green building practices within the design and construction field remains low. Major corporations now offer products and services at a scale that is bringing costs down to competitive levels, but environmental sustainability in building design and delivery remains at the early stages of the adoption s-curve.[6]

Because of quick urbanization, the utilization of assets has expanded tremendously prompting the outflows of Greenhouse gasses (GHG) in the air. Predominantly, the development business is the major worldwide exploiter of normal assets. So as to lessen the carbon impression, it is significant to think about the typified vitality of the material before use. Consequently, there exists a striking extension for the creating nations for actualizing the feasible standards. In this way, it is critical to discover the strategies, procedures and choices for improving the supportable idea in the urban biological system.[7]

Sustainability means the measures and initiatives that the companies take to survive themselves in the future market. With the increasing environmental and climate concerns, the stakeholders give importance to three corporate sustainability pillars (3 pillars of Sustainability by john Elkington in 1994, called Triple Bottom line are Profit, People and the Planet). In today's era the companies and businesses which manages to make profits keeping in mind the social and environment footprints can only sustain in the market for longer term.[4]

Green building rating systems

Various green rating systems are established globally to evaluate the sustainability of construction projects. Their categories and criteria have been under constant updates to follow the sustainable trend of building development. Although the rating systems were initiated in different contexts with different standards, Indoor Environment Quality, Energy, and Material are core common categories for all. Environmental concerns are the main focus in New Construction manuals while Society is emphasized in Neighbourhood Development manuals. Currently, BREEAM has been the only tool which could assess all four sustainable factors. Further in-depth research is anticipated to focus more on economic and institutional factors to improve the capability of green rating systems for sustainability assessment purposes.[9]

Green building rating systems have been developed to measure the level of sustainability of buildings. Existing methods can be applied to different regions by addressing additional aspects such as varied climatic conditions and regional variations. The most widely used environmental building assessment methods are, namely BREEAM, LEED, SB-Tool, CASBEE, LEED-India, GRIHA and Eco-housing. Comparative studies revealed that the existing assessment schemes had some limitations when applied to an Indian built environment. This necessitates the development of a new building environmental assessment scheme.[6]

The greenness of a building is measured through green building assessment tools. These tools have limitations because they cannot be applied to all regions. [4]

Composite Materials used in green buildings

Construction of green structure are seen to be growing rapidly in India with handholding profit in economic sector of construction. As it is eco-friendly, easy to construct and budget oriented, builders and engineers are absorbing this technology for a viable construction and development. These structures are also very productive along with saving the resource. Keeping the profit and other benefits, nowadays architect, builder and policy maker are focusing more on the green building construction in India where we have seen in past year almost 6-8 Indian states provide incentive for green building development.[11]

Natural fibres are low-cost, locally available in abundance and obtained from renewable resources. At the Central Building Research Institute, Roorkee, the potential of sisal and jute fibres as reinforcements have been systematically investigated to overcome their well-defined problems of moisture absorption. The performance of polymer composites made from these natural fibres and unsaturated polyester/epoxy resin was evaluated under various

humidity, hygrothermal and weathering conditions. Consequent to this, various composite products such as laminates/panels, doors, roofing sheets, shuttering and dough moulding compound have been prepared. The suitability to these products is assessed as an alternate material according to the existing Indian standard specifications.[12]

They can be used as reinforcements in composites. NFs obtained from vegetables constitute cellulose, a polymer of glucose bound to lignin with varying amounts of other natural materials. Synthetic, or man-made fibres are generally obtained from synthetic materials such as petrochemicals, but some types are manufactured from natural cellulose, including rayon modal and lyocell.[13]

Various waste materials can be used to prepare composite. Bio degradable wastes such as agriculture waste, rice husk ash can be used for manufacture of composite materials. Hazardous wastes like fly ash, geopolymer, silica fume, red mud, Bauxite, GGBS can be used as partially in concrete. This use of wastes in concrete resolves the land pollution issues caused by open dumping in yard.[11]

Energy Efficiency in Green buildings

Buildings are the prime energy consumers in modern cities accounting up to 40 to 45% energy consumption. Their consumption can be largely confined through improving efficiency, which is an effective means to lessen greenhouse gas emissions and slow down depletion of fossil fuels. There is a heavy (over 50%) saving potential in the building sector and thus it is considered as a potential sector to meet the challenges of global energy demand and climate change. Along with the advent of energy efficient measures, more effective means are needed to induce or compel greater efforts, especially to the signatories of the Kyoto Protocol.[11]

The International Energy Agency released a publication that estimated that existing buildings are responsible for more than 40% of the world's total primary energy consumption and for 24% of global carbon dioxide emissions.[1]

Improving the energy efficiency of buildings is a growing priority on the policy agendas of many countries and of the international community. The International Energy Agency, the IPCC and the United Nations Environment Program have recently released recommendations to mitigate greenhouse gases emissions and reduce energy consumption of buildings. Some of these recommendations include strengthening the regulatory energy standards for new buildings, controlling the quality and maintenance of existing buildings, encouraging energy-saving behaviour by home owners and stimulating the diffusion and innovation of energy-efficient technologies. Technological innovation, in particular, could play a large role in reducing further the energy consumption of buildings. The energy efficiency of insulation materials, heating systems, and other appliances has greatly improved over the past decades and recent developments in solar boilers, geothermal energy or lighting technologies have been also very promising.[14]

Energy efficiency is one of the most essential aspects of the sustainability of buildings. The energy efficiency potential of buildings, which depends on the chosen architectural and layout solutions, can be assessed using various building energy efficiency methodologies. The ability of a building to save energy – aside from thermo-dynamic and heat retention qualities of materials – depends on its shape, orientation, layout of transparent envelopes, size, measures of protection from the sun, and the facade colour.[15]

Cost Comparison

Green buildings are commonly perceived to be a lot more expensive than conventional buildings and often not worth the extra cost. The cost of green design has dropped in the last few years as the number of green buildings has risen. The majority of this cost is due to the increased architectural and engineering (A&E) design time, modelling costs and time necessary to integrate sustainable building practices into projects. Generally, the earlier green building features are incorporated into the design process, the lower the cost. Green Buildings provide financial benefits that conventional buildings do not. These benefits include energy and water savings, reduced waste, improved indoor environmental quality, greater employee comfort/productivity, reduced employee health costs and lower operations and maintenance costs.[16]

Recent increases in the supply of green buildings and the volatility in property markets have not affected the returns to green buildings. The economic premiums for green buildings to their relative efficiency in energy use-the attributes rated for thermal efficiency, as well as sustainability, contribute to premiums in rents and asset values. Among green buildings, increased energy efficiency is fully capitalized into rents and asset values.[17]

Several studies suggest green construction can result in significant economic savings by improving employee productivity, increasing benefits from improvements in health and safety, and providing savings from energy, maintenance, and operational costs. Results show that in a new facility manufacturing productivity increased by about

25%; statistically significant absenteeism results varied; and energy usage decreased by about 30% on a square foot basis after adopting to build a green facility.[18]

Based on the comparison of 17 green buildings' actual cost data against modelled cost estimates, it is concluded that, on the whole, green buildings are not inherently more expensive due to their provision of sustainable materials and systems. Although the green buildings analysed have shown higher costs on average, a sizable portion of buildings have been found to be below modelled costs. Knowing which building elements tend to attract premiums, or savings, will allow these costs to be effectively addressed through cost management techniques and possibly through use of innovative project delivery methods such as integrative design.[2]

Conclusion

The results computed at end of the paper give an easy understanding about the differences, benefits and a basic comparison between a conventional office building and a green sustainable one. The cost comparison will help in the economics of green office buildings. The environmental impact benefits will help companies in their goals to be more eco-friendly. Therefore, this will help spread awareness in the country and motivate developers, consumers and architects to make a move towards greener sustainable buildings.

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