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Green buildings: a Real Estate reality or Marketing Fad

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Abstract

The paper studies the importance of Green buildings in today's Built environment. Green buildings or green architecture are not just a design element or architectural elements for the environment but a major business move. Energy saving aspect makes a green building or a sustainable building so important today. With the depleting energy resources, saving energy is of paramount importance. The built environment generates almost 50% of Carbon dioxide emissions. Out of which, 27% I by building operations and the building materials contribute to almost 20% of it additionally. The built environment is responsible for more than 50% of total energy consumption.

The paper studies the need for the green buildings, the characteristics of the green buildings, their architectural value, their constructional elements, their planning, the different types of material used and design principles to create a green building. The various rating systems in India and used around the world have been studied. While studying the architectural principles is important, it is equally important to understand the business of green buildings. The business of built environment is not just the design but the finance that affects real estate. The paper pays attention to the business side of green buildings and its impact on built environment. The different costs included and the expense saved by sustainable architecture in India and all around the world. Various buildings are studies and several experts are interviewed to understand the need, motives, importance and impact of green buildings in the business of built environment.

Keywords: Real estate, architecture, built environment, sustainability, green buildings

1. INTRODUCTION

Going green is an innovative way of incorporating our day-to-day life elements like where we live, work and learn into the nature around us. The best way to do this is designing and building structures and cities that complement the environment. But we have often found that the cities and buildings being designed only contribute in degrading the environment and alienating us from nature. The contemporary movement toward green construction has lessened the built environment's negative environmental effects. However, the market for green structures has yet to grow as expected. This is the final piece needed to achieve fully sustainable development and a nation with a healthier built environment. It is an amalgamation of conscientious architecture and engineering excellence. It uses less water, optimizes energy efficiency, conserves natural resources, generates less waste and provides healthier spaces as compared to a conventional building.

Green building design involves finding the balance between built environment and natural surroundings. This requires a strong partnership between the architects, the engineers, developers and the end users at all stages.

2. CHARACTERISTICS OF GREEN BUILDINGS

Green buildings are characterized by several elements.

- water and energy resources to be utilized effectively
- Management of material resources and waste
- Restoration and protection of environmental quality
- Improving and safeguarding indoor environmental quality and health
- Reinforcement of natural systems
- Site Design and planning
- The analysis of the building life cycle costs. Along with it, the benefits of materials and methods are also done.

To reduce the environmental impact, one must follow two simple rules:

- The First rule - every building should have small foot prints (as small as possible).
- The Second rule – should not contribute to sprawl even if the most energy-efficient, eco-friendly methods of design and construction are used.

3. NEED FOR ENERGY EFFICIENT GREEN BUIDINGS

India must implement several crucial built environment policies in order to safeguard the nation's economic development, climate change, and energy use.

- **Increasing energy needs to fulfil national energy needs;** India is the fourth-largest energy user in the world. India must expand commercial energy production by about 41% if it wants to achieve its target pace of 8% annual growth by 2017. India can

achieve this by increasing its generating capacity by 88GW by 2017, of which 79% will come from sources that burn coal or lignite.

- **Energy security is at risk due to the growing gap between supply and demand for coal.** As coal reserves become harder to mine, it becomes more difficult for our country to expand its energy production and use. India continues to rely on expensive diesel backup generators during the frequent power outages due to the increased unpredictability of the electrical supply. These are all significant opportunities that ought to be taken advantage of and strengthened if we wish to reduce energy costs and boost energy security. This can be accomplished by planning and constructing energy-efficient structures.
- **Uncontrolled energy use has a negative impact on the environment;** commercial buildings are a major source of greenhouse gas emissions. This causes several health problems for the populace due to the changing climate. India's commercial structures produce roughly 78 million tonnes of carbon dioxide annually.

For making something energy-efficient the importance of green buildings cannot be overstated, both for environmental and financial reasons. By 2030, McKinsey and Company rates the global opportunity for energy-efficient buildings at more than Rs. 41 lakh crore, and they predict that India could save almost Rs. 83,000 crore annually by making this investment.

4. ENERGY EFFICIENT MATERIALS & CONSTRUCTION TECHNIQUES

We know there are several characteristics that separate a green building from a conventional one. But the most common and also probably the most important one is use of energy efficient building materials and techniques. There are several eco-friendly building materials that are both energy efficient and environment friendly and elegant. Building with such alternative materials can be tricky but rewarding at the same time.

- Earth Building or Adobe
- Straw
- Bamboo.
- Cordwood
- Papercrete
- Sawdust
- Cast Earth (Poured earth).
- Green Lumber (from certified growers)
- Recycled stone
- Recycled metal
- Blown-in fiber glass insulation
- Lower volatile organic compounds
- Other recyclable products
- **SIP**-Structural Insulated Panels

- Living roofs or green roofs
- Solar roofs
- Solar and SPF roofs

5. THE ENERGY & RESOURCE INSTITUTE

TERI -The Energy and Resource Institute in India has developed GRIHA, Green Rating for Integrated Habitat Assessment an instrument for rating buildings on their 'greenness'.

5.1. INDIAN GREEN BUILDING COUNCIL

The Indian Green Building Council (IGBC), established in 2001, is the country's first program specifically designed for the residential sector. In India, there are essentially 3 recognized rating systems:

- GRIHA
- LEED
- BEE

- CII that is the Confederation of Indian Industry established the IGBC in 2001.
- The Leadership in Energy and Environmental Design (LEED) Green Building Standard has been licenced by the Indian Green Building Council (IGBC) from the U.S. Green Building Council.
- The IGBC-licensed LEED is in charge of approving new green buildings, LEED-New Construction buildings, and LEED-Core and Shell buildings in India.
- The complete-building strategy for sustainability is promoted by IGBC.

Following are the five key areas of sustainability:

- Sustainable site development
- Water savings
- Energy efficiency
- Materials selection
- Indoor environmental quality

5.2. BUREAU OF ENERGY EFFICIENCY

The Bureau of Energy Efficiency (BEE) launched an Energy Conservation Building Code (ECBC). It is a Star Rating Programme started in 2009, for office buildings in order to accelerate the Energy Efficiency activities in commercial buildings.

A building's location plays a very important role in determining its energy efficiency. It helps in temperature and natural lighting of the structure. The trees, hills and landscaping provide shade, proper placement of windows and skylights and use of architectural features that reflect light into a building can all contribute in reducing the requirement of artificial lighting.

To create a structure that is Green and energy efficient, the following measures have to be followed:

- System Efficiency
- Renewable Energy
- Costs - though the initial investment for green and energy efficient buildings are more than conventional buildings, in the long run the maintenance costs for a Green building is lot less than a conventional one. The costs may be earned back over time with low energy bills and lesser water usage.
- Green materials
- Water and Waste management

6. ENERGY CONSUMPTION BREAK-UP

The following pie-chart shows the break-up of the total amount of energy consumed by a conventional building:

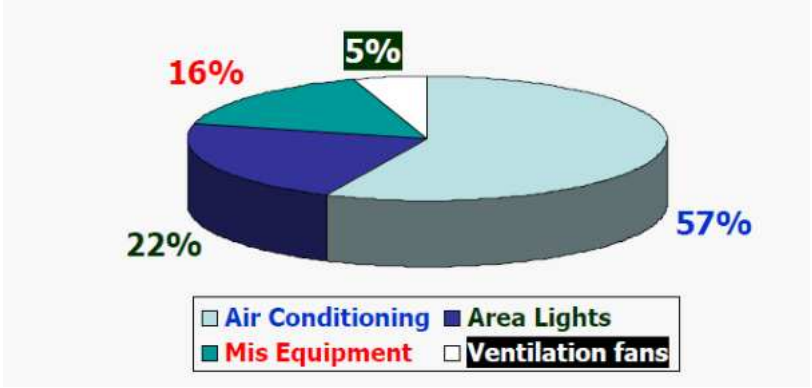

Figure 1: Energy consumption break-up

7. COOLING LOADS COMPONENTS

The following pie-chart shows the break-up of heat gains via various building structural elements.

There are 3 major sections of which utilize the LEED and BEE measures and hence save energy which in turn saves money.

- SITE
  - Keep and reuse any existing buildings
  - New buildings should be strategically located to maximize energy performance
  - Plant local plants and trees
  - Rain water harvesting and storm water catchment provisions
  - Use rainwater and treated waste water for flushing and cisterns
- BUILDING CONSTRUCTION
  - Roof over hangs for shading
  - Use of photo voltaic solar arrays
  - Increased wall thickness for maximizing insulation
  - Geothermal HVAC systems
  - Use of skylights and day lighting
  - Very low and no use of VOC compounds in paints, adhesives or sealants.
- INTERIORS
  - Flooring made by renewable materials
  - Low flow toilets
  - Automatic flush valves in toilets
  - Appliances that have "energy star" rating
  - Light switches with sensors

Various sections that help in saving energy and cost:

- ORIENTATION – saving potential – 2-3%
- Wall options
  - ACC Block - saving potential - 3-8%
  - Brick wall with 75mm extruded polystyrene insulation – saving potential – 3-8%
- Wall insulation – saving potential – 3-8%
- Roof insulation – saving potential – 3-8% on size of roof
- High Albedo roofing material – saving potential – 2-3%
- Roof Gardens – saving potential- 1-2%
- Low U glass and glazing – saving potential- 6-8%
- Thermal Break – saving potential -1-2%

8. Business of green buildings

Green buildings today can be delivered at a price comparable to conventional buildings and investments can be recouped through operational cost savings and, with the right design features, create a more productive workplace.

- **Design and Construction Costs:** As building codes around the world become stricter, supply chains for green materials and technologies mature, and the industry becomes

more skilled at delivering green buildings, there has been an overall trend towards the reduction of design and construction costs associated with green building

- **Asset Value:** Buildings with greater sustainability credentials will be more marketable as investors and occupiers become more aware of and concerned with the environmental and social implications of the built environment. Additionally, there is evidence that suggests a connection between a building's green attributes and its capacity, in some markets, to more readily draw tenants and to command higher rentals and sale prices
- **Operating Costs:** Green buildings have been found to minimize operating and maintenance expenses over the long run and use less energy and water. Within a fair payback period, the energy savings alone often outweigh any cost premiums related to their design and construction;
- **Workplace Productivity and Health:** Increasing amounts of data point to the possibility that workplace productivity and occupant health and well-being may be influenced by the physical features of buildings and indoor spaces, with positive effects on firms' bottom lines
- **Risk Mitigation**: The rental revenue and future value of real estate assets can be strongly impacted by sustainability risk factors, which in turn might reduce their return on investment. Around the world, regulatory issues such as required disclosure, building codes, and laws prohibiting inefficient constructions have become more and more obvious.

An impediment to green development is the upfront cost. Two distinct construction cost components account for the higher price of green buildings.
These are:

- Design
- Fittings and finishes, including flooring and lighting options. Fittings and finishes cost more than conventional building designs by 32% and 28%, respectively, and green building design prices are 32% more.
- Green building construction also takes 11% longer than construction of a conventional building of comparable size, the researchers found. As a result, builders take longer to wait for rental income or a sale of the project. On a comparative basis, the average internal rate of return (IRR) for the developer is 2.6% lower on a green certified project.

9. GREEN BUILDINGS in India: Real OR just a MARKETING FAD?

The concept of green building has been doing the round for quite some time. Specifically in India, ancient architecture is a clear indication that historic buildings some as old as 500 years of age were designed and built as a "Green Building or Sustainable Building" as is called today, example the "Hawa Mahal", "Chand Baoli", "Golkonda" etc. So why the sudden craze about it today? It has already been proven it is not a new concept.

The first reason is the sudden Need for these buildings. With increasing global warming, high energy consumption and depleting natural resources, there is a call for a kind of built

environment that doesn't contribute in poisoning the nature, or at least minimize their negative impacts.
There is an increase in awareness in all classes:

- Developers, Tenants and Owners.

Along with environmental benefits, Eco-friendly structures feed the materialistic hunger of man. It is "Good in all business and financial senses", as it is put by Developers and Owners.

DEVELOPER would want to invest and build a green building or green society because it gives;

- High sale price
- Quicker sales
- Lower design costs

TENANT would want to lease out such a building because;

- It has high productivity
- Healthy living and working conditions

OWNER would want to invest because;

- It has slower depreciation rate
- Lower exit yields
- Increased occupancy rates

Green Building is a marketing phenomenon in itself.

This is because such a building has the ability to secure finance for developers and owners. Gives rapid returns on investment and reduces vacancies.

It reduces operating costs and lowers maintenance costs for owners and tenants. However, the most satisfying reason for all three; Developer, Owner and tenant are lower refurbishment costs, lower transaction costs and increases the Corporate image and Prestige value for all three.

There are several architects and designers who are dedicated especially to create and advance this new phenomenon. Indian Architects are specializing in green architecture to create real eco-friendly structures and not just for marketing purposes as was the trend till a few years back.
The best green architects and architecture firms in India:

- Ashok LLal
- Dr. Arvind Krishnan
- Anupama Kundoo
- Fabian Ostner
- Helmut

10. MARKET BENEFITS

10.1 TANGIBLE BENEFITS

- Unique Selling Point: most new developers have adopted the new marketing strategy of selling their buildings on their sustainability and comfort to consumers which includes cleaner atmosphere; natural day-light, ventilation. Industry stakeholders have understood the fact that going 'green' is not an option but an absolute necessity in the light of global environmental concerns.
- Maintenance: green buildings need less maintenance.
- Higher Property value: a green building consumes less energy. It being a net zero energy building is an active building and one can earn from it. Green buildings have high sale value because of its alternative components.
- Economic Benefits: according to studies, one can save up to 18 dollars in cost of energy from increased thermal efficiency of green certified building.
- Tax benefits: tax provisions are introduced to encourage the construction of green buildings.
- Improved retail sales: just like green corporate offices were healthy work environment draws more employees, a commercial center attracts more people when it has a healthy earthy ambiance.

10.2 INTANGIBLE BENEFITS

- Environmental Concern: Buildings consume a significant amount of other natural resources, such as water and natural materials, and generate around 40% of the world's greenhouse gas emissions, according to the United Nations Environment Programme (2009). According to Royal Institute of Chartered Surveyors, RICS (2005), buildings and the construction activity that goes along with them are responsible for at least 30% of global greenhouse gas emissions. The conventional materials won't get us very far. Research on alternative uses for it, such laminated bamboo, will result in the creation of sustainable goods made of locally sourced and renewable resources.
- Improved Employee Attendance & Productivity: Healthy employees work in healthy environments. Therefore, this indicates productive workers. People are less ill, which results in fewer sick days.
- Healthier environment : happy residents

10.3 MARKET DRAWBACKS

- Air-Cooling Features: the only component that influences the air temperature in a green building is the natural ventilation. Natural ventilation cannot be regulated and artificial air conditioning is absent in such structures.
- Availability of materials
- Time: designing and construction of such buildings are highly time consuming.
- Green roofs: green roofs consist of several layers including vegetation, drainage, water proofing and roof support.

- Cost: A green building or green community requires a significant initial investment.

11. OVERCOMING HURDLES FOR DEVELOPERS

- Rebates on taxes and property premiums
- Floor space index allowances
- Energy service companies
- Special economic zones
- Building rating systems

11.1 MARKET IN INDIA

- India has enough potential for creating a large successful market for green buildings.
- The present infrastructure is not capable for withstanding the growing urban population.
- For this a fund of Rs.1292.37 billion has been set up to improve the infrastructure of 60 major cities of India under the ambitious Jawahar Lal Nehru national urban renewal mission (JNNURM).

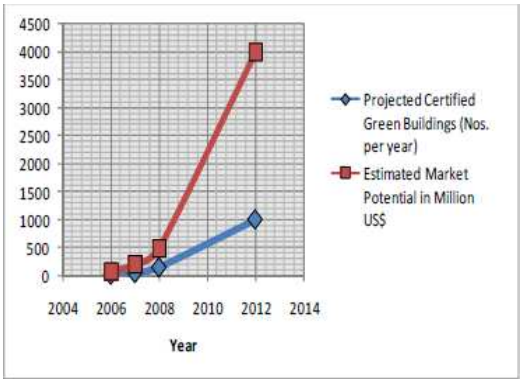

Figure 2: projected potential of green market

12. GREEN BUILDINGS IN INDIA

- Rajasthan government is planning to make it mandatory for buildings spread over 500sqmt to have rainwater harvesting facilities, solar panels and green cover with plants and trees for promoting the green building concept.
- The US Green Building Council (USGBC) today said that 833 million sqft of green building space in India is LEED-certified.
- The world's leading program for the design, construction, maintenance, and operations of green buildings is the USGBC's LEED green building certification system. Every day, 1.7 million square feet of space get LEED certified.

12.1 Notable Green certified buildings in India

- Degree College and Hill Council Complex, Leh
- Airport and staff housing colony, Kargil
- The Druk White Lotus School, Shey, Ladakh
- PEDA office complex, Chandigarh
- Centre for Science and Environment (CSE), New Delhi
- Transport Corporation of India Ltd, Gurgaon
- SOS Tibetan Children's Village, Rajpur, Dehradun
- Redevelopment of property at Civil Lines, Delhi
- Integrated Rural Energy Programme Training Centre, Delhi
- Water and Land Management Institute, Bhopal
- Baptist Church, Chandigarh
- Solar Energy Centre, Gual Pahari, Gurgaon
- National Media Centre Co-operative Housing Scheme, Gurgaon
- ITC Centre, Gurgaon
- CII - Sohrabji Godrej Green Business Centre, Hyderabad
- Green Leaf Hotel, Jasola
- Torrent Research Centre, Ahmedabad
- Solar passive hostel, Jodhpur
- TERI office building-cum-guest house, Bangalore
- Office building of the West Bengal Renewable Energy Development Agency, Kolkata
- Office-cum-laboratory for the West Bengal Pollution Control Board, Kolkata
- Silent Valley, Kalasa
- Vikas Apartments, Auroville
- La Cuisine Solaire, Auroville
- Kindergarten School, Auroville
- Visitors' Centre, Auroville
- Computer Maintenance Corporation House, Mumbai

13. ENERGY EFFICIENCY THROUGH GREEN BUILDING CONCEPTS

CII – GODREJ GBC

- LOCATION – HYDERABAD
- CLIENT – GODREJ GROUP
- LEED-PLATINUM
- BEE-5 STARS

ITC GREEN CENTRE

- LOCATION – GURGAON
- CLIENT- ITC
- LEED-PLATINUM
- BEE-5 STARS

WIPRO TECH.

- LOCATION – GURGAON
- CLIENT – WIPRO
- LEED – PLATINUM
- BEE- 5 STARS

14. INFERRENCE OF THE 3 PLATINUM RATED BUILDINGS

On studying the 3 platinum rated projects in our country we have inferred the following result:

BUILDING	SQFT	CONVENTIONAL BUILDING (KWH)	PLATINUM BUILDING (KWH)	% REDUCTION	ANNUAL ENERGY SAVING (in lakhs)
CII – GODREJ GBC	20,000	3,50,000	1,30,000	40%	102
ITC GREEN CENTRE	1,70,000	35,00,000	20,00,000	45%	90
WIPRO TECH	1,75,000	48,00,000	31,00,000	40%	102

15. MARKETING STRATEGIES

15.1 ADVERTISING

Advertising and promoting the Green concept is essential to make it popular. There is a need to inform the consumer about benefits of green to stop the pressure of built environment on the nature. All sectors of real estate should accept the benefits of Green buildings. It scored 5 stars, being the highest in GRIHA under the system. Such examples must be communicated to the society in a big way.

15.2 Knowing the Benefits

It is time to make the consumer realize the cost benefits of green buildings so that they accept and learn to use the alternatives like how it protect biodiversity and eco systems,

reduces waste streams, improve air and water quality and conserves natural resources. The new developments in this arena are helping to make such building in a cost effective way.

16. INDIA MARKET AS PER LEED RATINGS

- Cost Economics
  - Silver costs about 2% more
  - Gold costs 3-7% more
  - Platinum costs 12-18% more
- Do current valuations reflect greenness?
  - No, there is no explicit rent premium
  - But, effective rents are higher by about 2.5% (due to faster leasing time, better tenant covenants and lower vacancies)
  - Gives a valuation premium of about 2%.

16.1 COSTS

- DESIGN COSTS – The costs are dependent upon the rating.
- COORDINATION COSTS – Very high and time consuming. Research takes a long time.
- CONSULTANTS COST

There were 2 external consultants taken up on board for the project.

- LEED consultant
- Third Party Commission- A third party commission checks the design and on behalf of the architect files the registration papers for LEED rating.

16.2 REGISTRATION COSTS

- It depends on the size (per sqft) of the building. Bigger the size, higher the cost.
- LEED consultant inspects and approves registration
- Upon approval the building het a registration number

16.3 PAYBACK PERIOD

- Two ways of finding the payback period
- First is finding the payback period of the entire project
- Second is finding the payback period of each element or system separately
- Finding the payback for the entire building is more difficult and time consuming and leaves windows for errors

  Hence payback for individual system is better

17. QUESTIONNAIRE ON IMPORTANT ASPECTS OF A GREEN BUILDING PROJECT

Q.1.What cost is involved in construction of a green building?
Ans- 15-20% more as compared to conventional buildings.

Q.2. How much is the reduction in operating cost?
Ans- Per Annum reduction is in the order of 5-6%, than conventional building. Payback period is 5 yrs. This means that the extra money spend during construction pays back in 5 yrs.

Q.3.What is the current increase in cost for a green building a developer has to bare?
Ans. As answered above in Q.No.1.

Q.4.What is the social awareness of the people in case of green buildings?
Ans. No such social awareness. People may be aware of some components of green buildings such as energy efficiency.

Q.5.What is the current market for green buildings?
Ans. Huge potential.

Q.6. What are some strategies to make it more popular with investors?
Ans. Development of easy to implement techniques.

Q.7. Are green buildings profitable for investors?
Ans. No. It is more of a thing of a conscience and make the earth greener.

Q.8.What is the other different costs involved?
Ans. Post occupancy maintenance costs.

Q.9. what is the latest rating system?
Ans. In India there are two most sought after rating systems, GRIHA and LEED India.
The following Questions are answered directly by – **Mr. Ashok Kumar**
Senior Principal Scientist, (Head – Architecture and Planning Group & Efficiency of Buildings Group)

18. LITERATURE STUDY

- Majumdar, M. and Shah, S. Conducted a study and published a paper "Study of Life Cycle Costing for GRIHA Rated Green Buildings in India." on the life cycle costs of a GRIHA rated building in India. According to the study "Green buildings are boon to

investors, yielding high returns yielding high as compared to investments in conventional buildings or other investments, in a shorter duration."

- Eichholtz, Kok and Quigley (2009), conducted another research on commercial building that obtained LEED rating. The findings indicate that a commercial building with an Energy-Star certification, despite being otherwise comparable, will rent for roughly three percent more per square foot; the difference in effective rent is predicted to be about six percent. The increment to the selling price may be as much as 16 percent."
- Orlitzky and Benjamin (2001) deal with the relation between risk and corporate social performance. They argue that the market values of green buildings are inversely proportional to a firm's reputation. The better a firm's social standing, the lower its total market risk. If this holds true for the real estate sector, then building a green structure may result in a lower cost of capital and a higher building valuation. Hence, even if the green buildings did not command higher spot rents, they could still have a higher value.

19. CASE STUDY

PROJECT 1

NIRMAN SADA: JAYPEE CORPORATE OFFICE
CLIENT/OWNER – JAIPRAKASH ASSOCIATES LIMITED, NOIDA
ADDRESS – SECTOR 128, NOIDA ALONG YAMUNA EXPRESSWAY
AREA - 40,000 SQM
OFFICE SPACE – 53,000SQM
PARKING AREA – 43,000SQM
ARCHITECTURAL DESIGN – LE GROUPE ARCOP, MONTREAL & ARCOP ASSOCIATES PVT. LTD., NEW DELHI
ARCHITECT – Ar. RAMESH KHOSLA & Ar. SANJAY SINGH
DESIGN TEAM – TARIQ MUJB SIDDIQUE, G.SANGLIAN, RAMU NAGABATHINI, ANUBHAV JAIN, MANDEEP SINGH, VARUN SHARMA, BHARTI ARORA, GOLDY, SHIKHA AGARWAL
NUMBER OF FLOORS- 2 BASEMENTS + 6 SUPERSTRUCTURE FLOORS
RATING – LEED
RATING CLASS – PLATINUM
LEED CONSULTANT – SPECTRAL (AECOHM)
INITIAL COST - Due to its platinum rating its cost is **12-15%** more than an ordinary building.
LONG TERN MAINTENANCE SAVINGS

	BASE CASE	DESIGN CASE
COOLING	68,62,375	32,66,500
HEAT REJECTION	7,62,000	4,06,500
HEATING	18,04,125	4,12,500

HOT WATER	1,52,500	
FANS	37,98,125	16,33,000
PUMPS	18,77,625	14,46,000
EXTERNAL LIGHTS	10,95,000	4,82,500
EQUIPMENT	92,97,000	92,97,000
LIGHTING	84,56,000	45,37,000
TOTAL	Rs. 3,39,52,000	Rs.2,14,81,000
DIFFERENCE (LESS)		Rs.1,24,71,000
		36.7% SAVING

ENERGY CONSERVATION

A variety of methods were employed to conserve the energy usage of the building and maximize the energy performance. Some of these efficient measures are:

- Lighting – To reduce Lighting power Density to below 30% Ashrae 90.1-2004 baseline.
  - Daylight sensors are installed in all those areas exposed to daylight.
  - Occupancy sensors are installed in all office spaces to reduce the load on lighting
- HVAC System
  - On demand ventilation
  - Carbon Dioxide sensors
  - Variable Air volume system with pre-heat
  - Variable frequency drive on secondary pumps
  - Water cooling centrifugal chillers with high coefficient performance
- Building Envelope
  - Well designed overhangs 9m wide.
  - Jalis
  - Double glazed unit that is high performance
  - Roof having over deck insulation
  - ACC blocks in external walls
- Solar water heating system- to meet the requirements of hot water in kitchens and pantries, 10,000lts. per day capacity is installed.

For additional savings, load on fresh air is reduced by incorporating strategies like DCV sensors and exhaust air energy recovery.

As a whole, the project has accomplished to save 36.7% energy.

WATER CONSERVATION

As per the local bye-laws, the total space reserved for soft landscaping is 25%. However, this project reserved a total of 37.5% of the plot area. This helps with the stopping or arrest

of rain water run-off.all the storm water run-off from the office is collected in the ponds of the Jaypee Wishtown golf course which is then pumped back to the Nirman Sadan complex for horticulture purposes. Also the trees and plants chosen for landscaping are all tropical in nature and require minimum irrigation.

All the waste water from the toilets is collected in a Central Sewage Treatment plant. From here this water is treated and pumped back to the toilets of the building for flushing the water closets. Low water discharge cisterns and taps are also installed in the office building.

MATERIAL CONSERVATION

- Most of the materials used in the construction are locally available and transported from a distance of 800km to reduce carbon footprint.
- Renewable and environment friendly materials are used.
  - ACC (aerated autoclaved concrete blocks) used in external walls.
  - Timber (FSC certified wood)
  - Mosaic finish with wastage ceramic tiles on terrace. This also helps in reducing heat island effect.
  - Chemical compounds with low VOC for paints, coatings, adhesives and sealants.

PAYBACK PERIOD – 4-5 YEARS (ASSUMPTION)

RESEARCH ISSUES

- The issue of energy efficiency is more relevant for developed countries where one-third of the total energy is utilized for heating or cooling of buildings.
- When energy efficiency is used as the main criterion for green buildings in India, several critical issues tend to be ignored.
- For example, the issues of water and sanitation are more critical than energy efficiency in India.

20. CONCLUSION

With the onset of 21st century, the world felt an urgent need to pay serious attention to our mother nature. The entire world decided to start the Green revolution. India, decided to go back to basics and take pointers from our ancestors and forward the cause and create a Green country by 2030. More than 70% of the buildings proposed are all adhering to the Green Environment.

The Boom in Indian Real estate market only helped further this vision. All top tier cities jumped on the Green bandwagon. The cities leading are Bengaluru, National Capital Region (NCR) of Delhi, Mumbai, Chennai, Hyderabad, Kolkata and Pune.

Commercial buildings like, hotels, offices and retail malls all show high growth rate and are expected to grow more. The built-up area of one billion sqmt in 2009, commercial space will grow to four billion sqmt in 2030 (as estimated by Mckinsey)

Bureau of Energy Efficiency (BEE) estimates that to keep pace with the demand, construction of offices will have to increase by nearly 1.8 million sqmt a year in New Delhi, Mumbai and Bengaluru by 2030.

So far 123 buildings in India have been star rated for energy consumption of buildings.

While technology is a boon, it often proves to be a bane as well. Climatic conditions govern the choice of material and design. Mindless following of the "Green trend" can prove to be quite harmful. Many a time clients push and demand the architects to follow a certain style which may not be in agreement with the climatic condition of that particular location. Often the clientele without proper understanding of the situation demand the architects to design their projects following certain western elements or like their "favorite" building. This can be quite harmful for the environment as well as the inhabitants, not to forget the financial concerns of such a building.

Hence, a Green building has to be well planned, and requires proper coordination and cooperation amongst all the stakeholders at all stages to prevent the building going in negative directions. The Green built environment concept though relatively new, is rising on an insane rate. Hopefully the dream of a Green World, Green India is fulfilled at the earliest.

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