# PROJECT REPORT

# ON

# EVALUATING PERFORMANCE AND COSTING OF GREEN BUILDING

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PROJECT GUIDE

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ANJUMAN-I-ISLAM'S

KALSEKAR TECHNICAL CAMPUS

SCHOOL OF ENGG & TECHNOLOGY

PLOT # 3 &4, KHANDAGAON, THANA NAKA , NEW PANVEL,

(AFFILIATED TO MUMBAI UNIVERSITY)

2015-2016

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PLOT # 3 &4, KHANDAGAON, THANA NAKA , NEW PANVEL,

## DEPARTMENT OF CIVIL ENGINEERING

## CERTIFICATE

**This is to certify that the following students of VIII semester BACHELOR IN CIVIL ENGINEERING, have successively completed and submitted their project work during the year 2015-2016 titled as:**

**EVALUATING PERFORMANCE AND COSTING OF GREEN BUILDING**

**for stipulated in the syllabus for the award of BACHELOR IN ENGINEERING BY MUMBAI UNIVERSITY.**

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**(PROJECT GUIDE)** **( H.O.D)**

# ABSTRACT

Development is gradually converting the bio diverse habitat in to a concrete jungle which consists of an impervious cover to landscape resulting into a lack of woodland habitat and conservation of the most precious element on the earth "WATER". The vast canvas of built environment necessitates a greener color into it picture.

Sustainable development is a development that "meets the needs of the present without compromising the ability of future generations to meet their own needs" Sustainable construction tries to incorporate the general sustainable development concepts into conventional construction practices.

One of the ways to achieve sustainable construction is the **Green Building Design**, which is the core area of attention for greener built environment. Green Building Designs have environmental considerations as a basic scrutinizing criteria which attempts to integrate and achieve concepts of energy efficiency, water conservation and recharge, solid waste management, exploration of renewable energy resources, use of eco friendly materials and to minimize the negative impact on the nature, plant and animal species, non renewable material conservation and preserve resources and processes that prevail in nature. Several Green Building Rating Systems have been developed to objectively evaluate energy and environmental performance that spans the broad spectrum of sustainability.

In developing country like India where population increase squares the value every year, which had made her a potential global market leading to rapid urbanization and increased standard of living resulting into an upswing in construction activities. In an already hours of power cut off and load shedding situation this results into an extra burden on the conventional forms of energy

used traditionally by burning fossil fuels which endanger the earth by Green House Gas Emissions and an adverse effect on the environment. Keeping the collective goal of energy conservation and environmental protection, eco friendly buildings emerges to be the only solution for not compromising the development of the nation and at the same time using the resources judiciously for the optimum utility.

## LIST OF CONTENTS

RECOMMENDATION

CHAPTER 9 REFERENCES

# PREFACE

For the overall development of Civil Engineering student's project work is indeed very essentially for the grooming of a engineer. Practical knowledge definitely has an edge over a theoretical knowledge in a way that it only further enhances the technical skill of the student s in understanding the concept better. Visual effect has a long lasting impression as compared to theory which only adds to the practical knowledge of the students but at the same time the important of theory cannot be neglected. The start of this decade has revolutionized the civil industry in India. This can be explained by very fact that number of civil industries is growing more technically sound and efficiency too is increasing. Also technology is rapidly undergoing vital changes. It may be said that indication of nation's progress and development is mostly gauged through infrastructure projects like dams, roads, bridges, power stations, heavy industries and also utilities services like water supply, sewage system and waste management system.

One of the important components of urban infrastructure is Building Construction which has a direct impact on health and environmental safety of the city. We have made sincere attempts and taken every care to present this matter on Eco-Friendly Hotel in precise and compact form, the language being as simple as possible. The task of completion of report though being difficult was made quite simple, interesting and successful due to deep involvement and complete dedication of our department, professors and colleagues.

## ACKNOWLEDGEMENT

It is indeed a matter of great pleasure and proud privilege to be able to present this synopsis of project report.

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Really it is impossible to repay the depth of all the people who contribute in accomplishing the task of preparation of this synopsis report.

# CHAPTER 01

## Introduction to Green Building

### 1.1INTRODUCTION

The buildings in which we live ,work, and play protect us from nature's extremes. Yet they also affect our health and environment in countless ways. The design , construction operation ,maintenance and removal of building takes enormous amount energy water and materials generates lareg quantities of waste air and water pollution.

As the environmental impact of building becomes more apparent,a concept called green building is gaining momentum.Green or sustainable building is the practise of creating healthier and more reources efficient model of construction,renovation,operation,maintenance and demolition research and

experience increasingly demonstrate that when buildings are designed and operated with their

lifecycles impacts in mind, they can provide great environmental,economic and social benefits.

Worth noticing is that most of us talk about energy consumption and pollution because of

industry and transport when at least 40%of the total energy produced is consumed by buildings.

## 1.2BASIC CONCEPT:

The concept of Green Buildings envision a new approach to save water, energy and material resources in the construction and maintenance of the buildings and can reduce or eliminate the adverse impact of buildings on the environment and occupants.

A green building ethic is replacing the green building practices, whereby ildings built previously without thought to the negative impact on the viournment,are now being planned with a conservative approach to reverse s impact.

## 1.3 WHAT IS GREEN BUILDING:

" A green building is one which uses less water, optimizes energy iciency, conserves natural resources, generates less waste and provides althier spaces for occupants, as compared to a conventional building". " Green buildings are site specific and appropriately designed buildings, mg efficient water and energy technologies, renewable, recycled and cyclable building materials, and minimize the negative impact on the natural environment".

**1.4 BENEFITS OF GREEN BUILDING :-**


- Uses less water
- Use of recycled and eco-friendly building materials
- Is energy efficient
- Conserves natural resources
- Generates less water
- Provides healthier spaces for occupants, as compared to a conventional building
- Indoor air quality.

**1.5 WHY PEOPLE ARE ATTRACTED TOWARDS GREEN BUILDING:**

This question has been posed to several occupants of a green building. Ofall the many reasons, three top reasons often cited by those occupying these buildings are the following:

➢ Operational savings:

1. Green buildings consume atleast 40-50 % less energy and 20-30 % less water vis-•-vis a conventional building. This comes at an incremental cost of about
2. 2. 5-8%. The incremental cost gets paid back in 3-5 years time.

➢ Daylights & views:

1. Working in an environment with access to daylight and views provides connection to the exterior environment. This has a soothing effect on the mind. Various studies prove that the productivity of people who have access to day
2. Lighting and views is atleast 12-15 % higher.

➢ Air quality:

1. Green buildings are always fresh and healthy. Every green building willhave to purge continuous fresh air to meet the ASHRAE 62 requirements. The green

2. Buildings use interior materials with low volatile organic compound (VOC) emissions.

3. A typical office building would require purging of fresh air of about 15 cfm/person which provides a fresh ambience inside the building.

## 1.6 WHY TO OPT FOR GREEN BUILDING

These include:

1. Energy efficiency, renewable energy, and green power.

2. Location and alternative transportation.

3. Water conservation and low-impact development (storm water).

4. Waste reduction and recycling, and use of recycled-content products.

5. Local and regional sourcing of products and materials.

6. Passive strategies that rely on natural daylight and wind patterns.

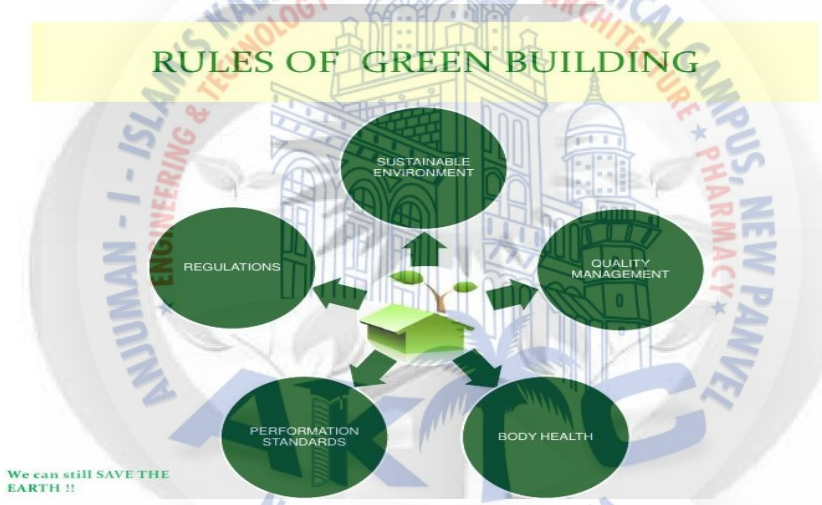
7. Healthy indoor environments. 8. Extended life cycles through durable, flexible and adaptive design.

# CHAPTER 02

# PERCAPTIONS AND REALITIES

Having covered on the benefits it is also important to know that people have different perceptions on greem building, some are coreect and some are otherwise.it is imsportant to look at these;

## 2.1 GREEN BUILDING ARE COSTLIER




REALITY : Considerable research and analysis has been carried out with regard to the cost impacts of green building. The cost could be slightly higher than

aconventional building. But then, this needs to be seen with a different paradigm.

The question is how do we compare the costs ? There needs to be a baseline cost forall comparisons to be alike

The incremental cost is always relatibe and depends on the extent os eco-friendly features already considered duering design. The incremental cost would appear small if the baseline design is already at a certain level of good eco-friendly Design; it would appreahuge if the base design has not considered green principles.

The second and rather a critical paradigm is to look at the incremental cost in ralation the life cycle cost. This kind of approach could be revealing . over its life cycle, the operating cost which is a onetime cost is only 8-10 %.

**2.2: GREEN BUIDINGS HAVE TO BE AIR –CONDITIONED :**

Reality : green buildings concepts and the LEED rating can be applied for non-air condtionin buildings. It has been applied on three such buildings in India viz., IGP office , Gulbarga,the royal engineering collage, Hydrabad and LIC office, shimoga.

While performing the energy analysis using software tools, such building will input the cooling system .Both in the baseline and the proposed design . This ensure that the building is recognised for any of the Other Energy Efficiency measures incorporated,
for example -the envelop, lighting, roof insulation etc.

This kind of an approach also ensures that an apple-to-Apple comparison is made while evaluating to Green building, weather conditioned and or not.

## Green building take more time:

reality :there is a General perception that going the greenway may affect the project schedules. this

was perhaps the case for the CII-Godrej GBC building when it was the first time that a green building

rating to Lords being applied in the country. The design in this case took about 1 and half years while

the construction was completed in about 9 months!

**CII-Godrej GBC, Hyderabad**

Thanks to the green building movement now there is so much of capacity building that has happened in the country. now, there is absolutely no difference in the time involved in constructing a green building vis-à-vis normal building. the time schedule for the reading can be synchronised with that of the green building this has been amply demonstrated in building like the Wipro in Gurgaon and grundfos in Chennai.

# CHAPTER 03

## LITERATURE REVIEW

### 3.1 LEED RATED GREEN BUILDING PROJECTS

**Platinum rated green building**

1. CII-Godrej green Business Centre Hyderabad
2. ITC Green Centre, Gurgaon
3. Wipro Technologies Gurgaon
4. Hiranandani BG building Mumbai
5. Spectral services consultants Private Limited Noida
6. ABN amro Bank Ahmedabad

**Gold rated green building**

1. Grundfos pumps India Private Limited Chennai
2. NEG Nikon India Private Limited, Chennai
3. Technopolis Kolkata
4. Olympia technology park Chennai
5. K Raheja Corporation C 30 BKC mumbai
6. Enercon India Private Limited Mumbai

**Silver rated green building**

1. L & T EDRC 1 Chennai
2. Hyderabad Institute of Technology and Management ,Hyderabad
3 World bank building Chennai
4.HSBC, Hyderabad

## 3.2 RATINGS OF GREEN BUILDING

The Rating System Worldwide :

- BREEM ( building research establishment environment assessment method)
- ASBEE ( comprehensive assessment system for building environment efficiency)
- GBTool
- Green Globes U.S.
- LEED ( leadership in energy and environment design)
- HVS ( hospitality valuation services) ECOTEL.

There's rating system requires varying levels of specialised sustainable design knowledge to be effectively used. A brief summary of the information provided in the document for each rating system included.

## 3.2.1BREEAM

BREEAM Has a long track record in the United Kingdom, but it is not extenaively used in the U.S. and it is difficult to obtain current information about the system. Based on the information available. It would not be applicable to all the GSA project types, specially tenant build out for leases . BREEAM is updated annually however the current version is not publicly available for purchase and must be acquired through a licenced assessor organisation determine the BREEAM rating based on quantifiable Sustainable design achievements. Although most Hindi sustainable design profession are aware of BREEAM many reading system have used it as there development basis, the rating system results are neither used nor recognised by U.S. design professionals.

## 3.2.2 CASBEE

CASBEE is the relatively new system developed for the Japanese market that is available in English, but has not been tested in the U.S. However, CASBEE is potentially applicable in the U.S. market and offers the unique "BEE approach" to performance evaluation data. Based on information available, it would not be applicable to all of the GSA project types, specially tenant build-out. The system requires documentation ofquantifiable sustainable design achievement which are assessed by trained, first-class architects, which have passed the CASBEE assessor examination. Major modification are expected to be made to the system every; however the process for those revision is unknown. Fewer than 10 building have used the system and all of those are in Japan, thus it is relatively unknown I the U.S. market.

### 3.2.3 GBTool

GBToo1 is an international system that has been used to evaluate U.S. building for the Green Building Challenge, including one GSA building. With respect to applicability to GSA project types , GBToo1 would be applicable for all but tenant out and operations and maintenance applications; however, an operation and maintenance version is under development. A third party team establishes the qualitative measures that are used to evaluate sustainable design achievement and expected building performance. The system has undergone 4 updates since its inception in 1998, which occur based on the experience gained through its use. Due to the flexibility inherent in the application of GBToo1, it tends to require greater technical expert to implement than other rating system, which has limited its exposure in the U.S. market.

### 3.2.4 Green Globe US

Green globes US was adapted from Green Globes Canada in 2004 and is the newest system considered in this review. Currently, U.S. version is not available for all of the GSA project types; however, Green Globes US is developing tools that address the major renovation, tenant build-out, and operation and maintenance applications. The Green Building Initiative received accreditation as a standard developer by ANSI and working toward developing Green Globe US as a n official ANSI standard.

### 3.2.5 LEED

LEED is currently the dominant system in the United States market and is being adapted to multiple markets worldwide. The currently available LEED rating systems address all of the GSA building and project types. A project Development and Maintenance Manual is publicly available which govern show changes are made to the LEED rating systems. The steps followed for the development of U.S. Green Building Council rating system products include technical development of committee, pilot testing, public comment period, approval by council membership, and then release for public use. For the existing LEED rating system, minor updates are occur no more than once a year, while major updates are expected to occur on a 3-5 year cycle, and will follow a defined process including a public comment period. Documentation of the quantifiable sustainable design measures are provided to the U.S. Green Building Council, the developer of the LEED rating system, for third-party verification. The assessors have been trained and must pass an assessor examination. More than 400 U.S. building are registered and therefore potentially seeking certification. LEED is not only the U.S. market leader, but is also the most widely use rating system by Federal and state agencies, which makes it easy to communicate a building's sustainable design achievements with others.

## 3.2.6 HVS INTERNATIONAL (ECOTEL)

HVS is the world's leading consulting and services organization focused on the hotel, restaurant, shared ownership, gaming, and leisure industries. Established in 1980, the company performs more than 2,000 assignments per year for virtually every major industry participant.HVS principle are regarded as the leading professional in their respective region of the globe. We are client driven, entrepreneurial, and dedicated to providing the best advice and service in a timely and cost-efficient manner. Through a worldwide network of 30 offices staffed by 400 seasoned industry professionals, HVS provides an unparalleled range of complementary services for the hospitality industry.

## Other National Rating Systems

- ❖ South Korea : Greening Building System
- ❖ Japan : CASBEE
- ❖ Australia : Nabers / Green star
- ❖ Brazil : AQUA/ LEED brazil
- ❖ Canada : LEED Canada/ Green Globes
- ❖ China : GB Evaluation standard for Green Building

- Finland : Promise
- France : Care & Bio, Chan tier Carbone and HQE
- Germany : DGNB
- Hong Kong : HKBEAM
- India : GRIHA (National Green Rating) / LEED India
- Israel : SI-5281
- Italy : Protocollo Itaca
- Mexic Sustentable : Consejo Mexicano de Edification
- Netherland : BREEAM Netherland
- New Zealand : : Green Star NZ
- Portugal : Lider A
- Singapore : Green Mark
- South Africa : Green Star SA
- Spain : VERDE
- U.A.E : Estidama
- United State : LEED/ Green Globes
- United Kingdom : BREEAM
- Taiwan : EEWH

## 3.3LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN (L.E.E.D)

### 3.3.1 LEED AN OVERVIEW

The U.S Green Building Council (USGBC), created LEED as a rating system for green building. Green building refers to the design, construction, and operations in an environmentally friendly way.

The LEED green building rating system evaluates environmental performance from a whole building perspective over a building's life cycle, providing a definitive standard for what constitutes a green building. LEED is a measurement system designed for rating new and existing commercial, institutional and high-rise residential buildings. The LEED rating system is the most versatile and widely adopted rating system in the world. Around 15 to 20 countries, the world over have adopted this rating system. Different buildings fall under different rating programs. Green buildings registered in India include corporate office complexes, IT parks, hospitals, Government offices, educational institutions, airports, hotels etc.

### 3.3.2 CRITERIA FOR CERTIFICATION

LEED promotes a whole-building approach to sustainability by recognizing performance in five areas of human and environmental health.

- Sustainable site development
- Water savings
- Energy effciency
- Materials selection
- Indoor environmeny quality

## 3.3.3 RATING SYSTEMS

The rating system is specific to the type of project being worked on. Some of the specific programs are

➢ LEED NC applicable to new commercial, institutional, and high-rise residential buildings.

➢ LEED-EB applicable to existing buildings, which includes criteria for maintenance, operations and

refurbishments.

➢ LEED CS for core and shell covers a building's structure, envelope and basic

mechanical/electrical/plumbing systems, which are items appropriate for speculative buildings.

➢ LEED CI for commercial interiors applicable to tenants fit-outs.

**Certification levels within the systems are:**

- Minimum points : Certified
- Second highest points : Silver
- Third highest points : Gold
- Fourth-maximum points : Platinum

Only six years into its existence, LEED is the best known green building rating system in the United States. There are over 450 LEED-certified projects with over 3,600 registered forcertification. This number is sure to increase with the full release of LEED-ND for neighborhooddevelopment programs and

LEED-H for individual homes, a collaborative effort with existing local green home programs, both of which are in the pilot phase and will follow a similar structure as the established LEED rating systems. Also in the discussion are versions tailored to retail, education, and other industrial sectors.

## 3.3.4 LEED POINT SYSTEM

A LEED rating is achieved through earning points in each of six categories. Within each category, there are subcategories including prerequisites. For example, the Sustainable Sites category contains a prerequisite for Erosion and Sediment Control, and also several other subcategories, including Sites Selection and Strom Water Management, for earning possible points if applicable.

**LEED-NC POINT SYSTEM**

| Category | Points |
|---|---|
| Sustainable Sites | 14 |
| Energy & atmosphere | 17 |
| Water Efficiency | 05 |
| Materials & Resources | 17 |
| Indoor Environmental Quality | 13 |
| Innovation & Design process | 15 |
| Total | 69 |

## Points Required for LEED-NC Ratings p.19

| Level | Points |
|---|---|
| Platinum | 52-69 |
| Gold | 39-51 |
| Silver | 33-38 |
| Certified | 26-32 |

The rating system is flexible in that it is performance-based, and does not force the applicant into following a narrowly defined set of specifications. The structure and categories in the rating system are often used as a basis for the newer systems that are being developed by other entities.

# CHAPTER 4

## ENERGY EFFICIENCY OF GREEN BUILDING

### 4.1 BASIC CONCEPT

The importance of energy efficient buildings has assumed great urgency today. In light of fast depleting energy resources, energy scarcity and increasing environmental pollution, innovative ways t cut down energy consumption are necessary. The construction industry is one of the largest energy consuming sectors. In modern buildings significant amounts of energy are also consumed to keep the building environment comfortable.
The residential, Commercial and institutional building sector consumes 31 percent of global energy and emitted 1900 megatons of carbon in 1990. By 2050, its share is expected to rise to 38 percent and 3800 mega tons respectively [IPCC 1996]. In India, estimates suggest that about 20 to 25 percent of total energy demand is due to manufacturing materials required in the building sector, while another 15 percent goes into running needs of the building. The Ministry of Power estimates that about 20 to 25 percent of the total electricity consumed in government buildings in India is wasted because of inefficient design parameters of buildings, which results in an annual energy related financial loss of about 1.5 bullion Rupees.

In developing countries like India, rising population, increasing standards of living and rapid urbanization result in an increase in building construction activities. This wil demand a larger share of the energy available in an already strained energy supply scenario. As most of the required energy is currently derived from buning fossil fuels, the building sector has emerged as a major factor impacting on the environment protection, eco-sensitive buildings or `green buildings' that utilize their resources judiciously, minimize their emissions and have efficient waste management systems, should be considered and designed.

## 4.2 HOW DO WE CREATE ENERGY EFFICIENT BUILDINGS?

Energy efficient and environment conscious building design is essentially an integrated approach. The available options in architectural intervention, building materials and design methodologies need to be carefully evaluated to minimize energy usage, minimize the ecological degradation that may be caused by the construction of the building and provide cost effective solutions, The aim is to achieve the desired comfort with the least output of conventional energy. Though the rules are not very well defined, architects and designers accomplish the task through solar passive design, use of renewable energy technology systems, and/or natural building materials. While designing such buildings, not only new building stock can be targeted but also existing buildings can be retrofitted with energy efficient and eco-friendly technologies, thereby substantially reducing energy consumption. In general, energy efficiency in new buildings can be achieved through:

➢ Bioclimatic architectural principles;

➢ Load minimization by the incorporation of solar passive techniques in building design;

➢ Design of energy efficient lighting and I-1VAC systems

➢ Use of renewable energy systems to meet a part of the building load; and

.➢ Use of low energy materials and energy efficient methods of construction.

➢ Basicenergy sources in an eco-friendly building complex

| SKY | SUN | AIR | EARTH | WATER |
|---|---|---|---|---|
| Day lighting | Heating<br>Electricity Generation<br>Day lighting<br>Green house Effect<br>Solar chimneys | Ventilation<br>heat sink | Roof gardens<br>earth berms for insulation | Roof pounds<br>fountians for humidification<br>Rainwater harvesting |

## 4.3 ENERGY EFFICIENCY

Energy conservation is possible by judicious design of lightning and HVAC (heating, ventilation and air conditioning) systems, controls and operation strategies. Increasing insulation levels in air conditioned buildings is regarded as the most cost effective investment in energy efficiency. Thermal insulation of external walls, roofs and floors, and double-pane windows can reduce energy consumption for space heating by lowering heat losses through the envelope of the building. Energy consumption for cooling is also reduced because of lesser heat gains from outside through the envelope. Energy efficient windows with their high thermal insulating values and spectral selectivity can make air conditioning systems work more efficiently. This can lead to reduction in AC loads, lower consumption of electrical energy and reduction in peak load demand [Bandyopadhyay 2011]. The use of energy efficient glazing helps in minimizing unwanted solar gains in summer and heat losses in winter, while maximizing the amount of useful daylight in buildings. Lighting load constitutes about 10 to 15 percent of the total electrical load of a building, and so energy efficient lighting systems, such as compact fluorescent lamps and fluorescent tubes with electronic ballast, aregenerally recommended instead of conventional lighting fixtures to reduce the lighting load.

Although the initial cost of such installation is high, they last longer and the running cost is also less. As electricity is efficiently converted to light in energy efficient lamps, the amount of heat generated is also less. The design and construction of buildings has a significant impact on the environment and the economy.

Green building consumes :

1. 45% of the world's total energy use;
2. 50% of all materials and resources;
3. 50% of wood ;
4. 35% of the world's $CO_2$ emissions;.
5. 80% of potable water use;
6. 25% of freshwater withdrawal (including power plants)
7. 40% of municipal solid waste destined for local landfills; and 50% of ozone-depleting CFCs still in use.

## TYPICAL GREEN BUILDING GUIDELINE ISSUES

- Energy efficiency and renewable energy:

  1.Building orientation to take advantage of solar access, shading, and ssnatural lighting

  2. Effects of micro-climate on building

  3. Thermal efficiency of building envelope and fenestration

  4. Properly sized and efficient heating, ventilating, and air-conditioning (11VAC) system

  5. Alternative energy sources

  6. Minimization of electric loads from lighting, appliances, and equipment

  7. Utility incentives to offset costs

## Direct and indirect environmental impact:

1. Integrity of site and vegetation during construction
2. Use of integrated pest management
3. Use of native plants for landscaping
4. Minimization of disturbance to the watershed and additional non-point-source pollution
5. Effect of materials choice on resource depletion and air and water pollution
6. Use of indigenous building materials
7. Amount of energy used to produce building material.

## Resource conservation and recycling:

1. Use of recyclable products and those with recycled material content
2. Reuse of building components, equipment, and furnishings
3. Easy access to recycling facilities for building occupants
4. Use of rainwater for irrigation
5. Water conservation in building operatiorr,
6. Use of alternative wastewater treatment methods

## Indoor environmental quality:

1. Volatile organic compound content of building materials
2. Minimization of opportunity for microbial growth
3. Adequate fresh air supply
4. Chemical content and volatility of maintenance and cleaning materials
5. Minimization of business-machine and occupant pollution source-.
6. Adequate acoustic control Access to daylight and public arnenitie,,

## Community issues:

1. Access to site by mass transit and pedestrian or bicycle paths

2. Attention to culture and history of community

3. Climatic characteristics as they affect design of building or building materials

4. Local incentives, policies, regulations that promote green design

5. Infrastructure in community to handle demolition-waste recycling

6. Regional availability of environmental products and expertise..

## 4.4 USE OF RENEWABLE ENERGY TECHNOLOGIES

Renewable energy systems are installed for meeting a partial load of the building, thus considerably reducing the overall electrical and thermal load. Solar energy could be utilized for a variety of purposes and in a number of ways : generating electricity, providing hot water, and heating, cooling , and lir.htninr, building. Solar photovoltaic can provide electricity for lighting. Solar thermal systems may be used for heating water or space heating and heater generates hot water at 60- 850 C and can conveniently he used tbr domestic use. The usefulness of solar water heater can be ascertained from the fact that a std. 100 lits capacity system can be installed as an alternative to electric geyser for residential use that can save 1500 units of electricity annually and could prevent the emission of 15 tons of carbon dioxideinto the atmosphere every year. It is estimated in India that the use of 1000 solar water heater of a 100 lit capacity each can contribute to a peak load saving of 1MW. In cold and sunny climate, solar air heaters can be used extensively to reduce demand for electricity and firewood for space heating. Solar electricity can be generated by integrating solar cells in buildings, on roof and facades, orby installing grid connected photovoltaic plants .It is an expensive proposition where gridconnected electricity is available, but for

Locations where conventional electricity is not available or the grid is far away, it makes an ideal alternative. Further ,'building integrated PV; systems may be installed for the generation of electricity generated during non working hours could be fed to the grid. Inclined roofs, if oriented in a right direction are an ideal support structure for PV modules

In moderate to high wind speed location, roof top aero generators may be installed for the generation of electricity. A sunspace or solarium, which comprises of a combination of direct and indirect Gain system. may be used to heat up the living space by convection and conduction through the mass wall. Technologies have been commercialized to convert this solid and liquid waste generated in a building to productive use in the form of bio-fertilizers, gas for power generation. cooking etc. The long term objective is thus to reduce building energy load in a cost effective manner such that renewable source of energy can meet and exceed energy demand in buildings.

## 4.5 LOW ENERGY MATERIALS AND METHODS FOR BUILDING CONSTRUCTION

The choice of building materials also substantially contributes towards reducing the energy load of buildings. The use of conventional energy can be minimized by use of low energy materials, efficient structural design and reduction in transportation energy. Thus when building materials and to make appropriate decisions according, to local conditions. Bamboo which is called the poor man's timber in India is also getting recognized globally as a suitable building material because it is eco-friendly and highly suitable for energy efficient buildings.

# CHAPTER 05

# DESIGN PRINCIPLES

## 5.1 PREDESIGN CONSIDERATION FOR GREEN HOTELS

### 5.1.1 Forming a Design Team:

1. Many building design teams consist only of the architect, the owner, and an engineer.This narrow perspective seriously limits the ability for any environmental design initiative from being implemented.

2. Assemble an interdisciplinary design team before the site selection process. That includes client, users if possible, engineers, landscape, maintenance staff, etc.

### 5.1.2 Collecting Data

The purpose of collecting data is to identify the assets and liabilities of each site. Each of the potential sites should be assessed in a manner.

Analyze all the proposed sites to determine site characteristics that will influence building design.

1. Study how the solar altitude, microclimate, and the topography will affect design (i.e. solar orientation, wind loading, floor elevations, potential for passive solar/daylighting)

2. Consider the climatic zone of the site. Each climatic zone (cold, temperature, hot-dry, hot-humid) have designed strategies to maximize the overall design (i.e. Passive solar vs. shading, deciduous vs. coniferous vegetation).

3. Perform soil andgroundwater testing. Avoid building on soils that are contaminated with agricultural or industrial chemical residues. Establishing a clean source of groundwater is important if the building is to be self-sufficient. Contaminated groundwater is likely an indication of nearby

pollution that may impact the building operation environmentally and economically.

4. Test soil suitability for bearing strength, additional slope structures, and infiltration. Test the native soil for bearing, compaction, and infiltration capacity. Assess the added cost of importing fill to the site to make the soil suitable for development.

5. Evaluate ecosystems for existence of wetlands and endangered species. Assess and identify any areas that may not suit building development or require special preservation or restoration.

6. Examine existing vegetation to inventory significant plant populations. Denote vegetation that may require special protection during construction. Identify species and populations such that the landscape designers can later mitigate any damaged areas with original elements.

7. Avoid stream channels, flood plains, wetlands, steep erodible slopes, and mature vegetation. Evaluate whether the interstitial spaces (i.e. between channels, plains, etc.) are enough for the proposed building footprint.

8. Map all natural hazard potentials. Disclude the site if there is evidence of significant past disturbances (i.e. 100-year flood level, slopes prone to slides, wind-damage, avalanche potential). Consider discluding a site if it is within the 100-year flood level (many jurisdictions provide or require the purchase of flood insurance for development within the 500-year flood level).

9. Diagram existing pedestrian and vehicular movement and parking to indentify patterns. Determine whether existing patterns fit the proposed design plan. Take advantage of existing patterns to reduce environmental impacts and infrastructure costs, or consider a different site.

10.Review the potential of utilizing existing local transportation resources. Attempt to share existing infrastructure (i.e. Parking facilities, shuttle buses) with neighboring developments to reduce overall costs and increase site efficiency.

5. Identify alternative site design concepts to minimize resource costs and disruption. 6. Remain flexible to take advantage of all sites assets in the design. 7. Review financial implications of site development, building, and projected maintenance costs. According for all life-cycle costs lead to an optimum choice. 8. Develop matrix of use and site compatibility index. Use the matrix to easily identify key assets and liabilities of each site. 9. Evaluate project site selection, based on all criteria.

Building construction and operation have extensive direct and indirect impacts on the environment. Buildings use resources such as energy, water and raw materials, generate waste (occupant, construction and demolition) and emit potentially harmful atmospheric emissions. Building owners, designers and builders face a unique challenge to meet demands for new and renovated facilities that are accessible, secure, healthy, and productive while minimizing their impact on the environment. Considering the current economic challenges, retrofitting an existing building can be more effective than building a new facility. Designing major renovations and retrofits for existing buildings to include sustainability initiatives reduces operation costs and environmental impacts, and can increase building resiliency.

## 5.2 DESIGN PRINCIPLES

The Main objectives of sustainable design are to avoid resource depletion of energy, water and raw materials; prevent environmental degradation caused by facilities and infrastructure throughout their life cycle; and create built environments that are livable, comfortable, safe and productive.

While the definition of sustainable building design is constantly changing, six fundamental principles persist.

1. Optimize Site/Exisiting Structure potential :

Creating sustainable buildings start with proper site selection, including consideration of the reuse or rehabilitation of existing buildings. The location, orientation, and landscaping of a building affect the local ecosystems, transportation methods, and energy use. Incorporate campus or military base. Siting for physical security is a critical issue in optimizing site design, including locations of access roads, parking, vehicle barriers, and perimeter lighting. Whether designing a new building or retrofitting an existing building, site designing must integrate with sustainable design to achieve a successful project.

2.Optimize Energy Use :

With America's supply of fossil fuel dwindling, concerns for energy independence and security increasing, and the impacts of global climate changing arising, it is essential to find ways to reduce load, increase efficiency, and utilize renewable energy resources in federal facilities.

3.Protect and Conserve Water :

In many parts of the country, fresh water is an increasingly scarce resource. A sustainable building should reduce, control, and/or treat site runoff, use water efficiently, and reuse or recycle water for on-site use, when feasible.

4.Use Environmentally Preferable Products :

A sustainable building is constructed of materials that minimize life cycle environmental impacts such as global warming, resource depletion, and human toxicity. Environmentally preferable materials have a reduced effect on human health and the environment and contribute to improved worker safety and

health, reduced liabilities, reduced disposal costs, and achievements o environmental goals.

5.Enhance Indoor Environmental Quality(IEQ) : The indoor environmental quality(IEQ) of a building has a significant impact on occupant health, comfort, and productivity. Among other attributes, a sustainable building maximizes day lightning; has appropriate ventilation and moisture control; and avoids the use of materials with high — VOC emission. Additionally, consider ventilation and filtration to mitigate chemical, biological, and radiological attack.

6.Optimize Operational and Maintenance Practices :

Considering a building's operating issues during the preliminary design phase of a facility will contribute to improved working environments, higher productivity, reduced costs, and prevented system failures. Encourage building operators and maintenance personnel to participate in the design and development phases to ensure optimal operations and maintenance of the building. Designers can specify materials and toxic chemicals and cleaners to maintain; and are cost effective and reduce life cycle cost. Additionally, design facilities to include meters in order to track the progress of sustainability initiatives, including reductions in energy and water use and waste generation, in the facility and on site.

5.3 CHECKLIST FOR GOOD DESIGN: 1. Building Orientation: A number of innovative techniques can be used to achieve good solar access. No matter what the house's design, and no matter what the site, some options for orientation will be more energy efficient than oth,:N. and even a simple review of the site will probably help you choose the best option. Upgraded levels of insulation :

It is possible to achieve very high energy efficiency with a "super insulated" design. But in many cases an advantage of passive solar design is that energy efficiency can be achieved with more economical increases in insulation. On the other hand, if very high energy performance is a priority—for example. in areas where the cost of fuel is high—the most cost-effective way to achieve it is through a combination of high levels of insulation and passive solar features.

3.Reduced air infiltration :

Air tightness is not only critical to energy performance but also makes the house more comfortable. Indoor air quality is too important and complex an issue for a complete discussion here, but in general, sun tempered and passive solar houses built according to the guidelines provide an alternative approach to achieving improved energy efficiency without requiring air quality controls such as air-to-air heat exchangers, which would be needed if the house were made extremely airtight.

4. Power window sizing location :

Even if the total amount of glazing is not changed, rearranging the location alone can often lead to significant energy savings at little or no added cost. Some energy-conserving designs minimize window area on all sides of the house- but it's a fact of human nature that people like windows, and window can be energy producers if located correctly.

5.Selection of glazing :

Low-emissivity ("low-e") glazing types went from revolutionary to commonplace in a very shorttime, and they can be highly energy-efficient choices. But the range of glazing possibilities is broader than that, and the choice will have a significant impact on energy performance. Using different types of glazing for windows with different orientations is worth considering for maximum energy performance: for example, using heat-rejecting glazing on west windows, high R-valueglazing for north and east windows, and clear double-glazing on solar glazing.

6.Proper shading of windows :

If windows are not properly shaded in summer- either with shading devices, or by high-performance glazing with a low shading coefficient—the air conditioner will have to work overtime and the energy savings of winter may be cancelled out. Even more important, unwanted solar gain is uncomfortable.

# CHAPTER 6

## Our Contribution

➢ FIVE WAYS IN WHICH YOU CAN GO GREEN, WITHOUT SPENDING A GREAT DEAL

While there's a long list of things you can do to secure your building a green certification, you can move towards sustainability by following these low-cost green building tips. Easy to implement and inexpensive, these simple strategies can drastically lower your project's environmental footprint.

### 1. Design for maximum natural day lighting:

Using natural light from the sun is the best way to reduce energy consumption and lower the carbon footprint of a building. It costs nothing and is also beneficial for the health of the occupants — research shows that people perform better in naturally lit environments. Day lighting helps to lower lighting costs, reduces the price of cooling and can be accomplished without any increase in the cost of construction.

Buildings can be designed to receive adequate daylight and reduce the requirement of artificial lighting through innovative use of facades, windows and open areas.

### 2.Use natural ventilation system:

Cooling costs make up for most of the energy consumption in any building. It is possible to cut down on cooling requirements by using a natural ventilation system. Windows can be used effectively to enable proper ventilation by taking advantage of the wind movement and thermal convection.

Natural ventilation reduces the need for air conditiofling and brings down power building. consumption. It also improves the indoor air quality as fresh air circulates in the Windows must also beprovided with overhangs to create a natural cooling system and reduce heat gain by screening out the sunlight. 3. Install water-efficient fixtures for toilets: Developers have little or no control over the consumption of water in their buildings once they are occupied by the owners. A smart way to ensure that the water consumption of the occupants remains low is to install water-efficient fixtures and toilets. Unlike old toilets that required 18-20 litres of water in every flush, new toilets use only about 6 litresper flush. Flow reducers can be fitted into the aerator at the tip of the faucet to lower the rate of water flow. Using low-flow showerheads instead of standard showerheads also leads to substantial water savings. Low-flow toilets can save more than 80,000 litres of water per year for a family of four. One can reduce the consumption of water by nearly 40 per cent simply by using flow reducers.

### 4. Use zero- or no-VOC paint:

No-VOC paints do not emit any volatile organic compounds and hence are environment friendly. Recent studies show that indoor air is usually between three and five times more toxic compared to outdoor air. Toxic emissions frompaint and finishes are the biggest contributors to this. Using zero- or low-VOC paints can thus improve the indoor air quality. Low-VOC paints also help to reduce toxins that cause allergy, while zero or no-VOC paints are ideal for places like hospitals, offices and schools, which need to maintain good indoor air quality.

### 5. Use fly-ash in concrete:

Fly ash, a by-product of coal-based power plants, is an excellent and inexpensive substitute for cement. Depending on the application, one can use 30- to 50-per cent fly ash mixed with concrete for construction. Using fly ash offers twin benefits: it reduces the amount of concrete needed for construction, and also increases the strength and durability of the concrete. In India, more than 60 per cent of power is generated through coal-based power plants. Using fly ash can reduce the environmental impact of cement production to a great extent. The government also encourages the use of fly ash in construction projects.

## COST EFFECTIVE MATERIALS:

Taking into a consideration, the shortage of conventional construction materials, attention has being diverted towards alternate building materials. Industrial waste like fly ash, phosphogypsum, blast furnace waste and agriculture waste like bagasse, saw mill wastes, rice husk, cotton and jute stalks.

### ➢FLY ASH:

Fly ash occupies a prominent position among the various alternatives materials of construction, because it is a manifold application. Fly ash is the fine residues obtain from the thermal power stations using ground or powdered coal as boiler fuel. Presently, over 40 million tones of fly ash is produce in the country in seventy thermal plants. The flying fine particles of ash from chimney of thermal power plant cause great nuisance to people living near to the plant, corrode structural surface and often causes respiratory diseases.Fly ash can be put into several beneficial use such as, for the manufacture of bricks, cement, aggregates and in thepreparation of concrete. Fly ash based Portland puzzolona cement is suitable for use wherever ordinary Portland cement is used under normal conditions. It has

1. Lower heat of hydration
2. Lower water requirement
3. Reduce permeability
4. Increase resistance to chemical attacks by sulphates, chlorides,etc
5. Reduce risk of alkali-aggregate reaction commonly known as cancer of concrete.

### ➢ BLAST FURNACE SLAG:

This is a waste produce from steel plants. In addition to the manufacture of blast furnace slag cement which has a high resistance to chemical attack and protects steel reinforcement, granulated slag can be utilized in the manufacture of super sulphite resistance. Slag fines can also be used as a substitute for sand. Small quantities of blast furnace slag are used to manufacture slag wool and also for road construction in steel plants.

## ➢ RED MUD:

This Alumina red mud or bauxite reject is an important inorganic waste material from Aluminium producing industry. The bricks made from red mud can be dried traditional manner and fired in the existing type of kilns. They have brown, orange, or golden yellow and can be architecturally used as facing blocks in multi-storied buildings. With 4- 5% alkali, they have good plasticity and bonding characteristics in brick work.

## ➢ PHOSPHOGYPSUM:

This is the by-product from the fertilizer and phosphoric acid plant. After fly ash this is the second largest pollutant. Around five million tonnes are annually produced from the industrialplants. It can be efficiently used for making light weight gypsum plaster boards and blocks, panels for wall partitioning, slotted tiles for wall cladding, as decorative boards for roof ceilings and for making super sulphate cement.

## ➢USE OF SECONDARY SPECIES OF TIMBER:

Timber is the costly construction material. Its wide usage has led to shortage of good quality timber and deforestation. Hence vigorous attempts were made in research institute for timber substitution. The Forest Research Institute in Dehradun has identified more than hundred secondary species of timber which could be gainfully used in construction after proper seasoning and chemical treatment. It is estimated that about 20% of the total timber used in building construction is now secondary timber.

## AGRICULTURAL WASTES

| SR NO | ITEM | SOURCE | QUANTITY available in (M.T/year) | APPLICATION |
|---|---|---|---|---|
| 1 | Rice Husk | Rice mills | 18.00 | As a feul , for manufacturing Of low cost material and products for production of materials and fibrous building panels bricks. |
| 2. | Cotton stick | Cotton plantation | 10.05 | Fibre boards, panels door shutters |
| 3 | Ground nut shell | Ground nut oil mills | 5.75 | In the manufacturing of building panels,building blocks for making cheaps |
| 4 | bagasse | sugar | 5.25 | For manufacturing of insulation boards, industrial wall panels etc |
| 5 | jute stick | jute industry | 2.05 | For making chips board roofing sheets |
| 6. | saw mill waste | saw mills and wood based panel | 2.00 | For making of cement bounded wood chips , blocks, boards fibre boards insulation boards etc |
| 7 | banana leaves and stalks | banana plants | 0.20 | In the manufacturing of building material like boards, Fire resisitance fiber board. |
| 8 | coconut husk | coir fibre industry | 0.60 | In manufacturing of building boards, roofing sheets insulation boards and ligh weight aggregates. |

# CASE STUDIES

## INTRODUCTION :

This chapter deals with different types of case studies which gives closer insight of many green buildings and their application in the real world. It gives detailed over view of differenttypes of projects carried out in India.In this chapter many case studies are included first case study on Orchid hotel and Rodas hotel. Second case study is on rain water harvesting in which rain water harvesting system is applied on Government polytechnic Mumbai institute. In this case study we have given all details and briefly explained the required aspects.Roshni project is done on Rashtrapati Bhavan& president's Estate which is a small township. The work had started on 5th June 2009 and completed on 5th July 2009. The fourth case study deals with solar energy, it is also applied in roshni project. Next case study is on vermi-composting pits (Roshni Project) President estate has a large green area and this area is used for vermi-composting to reduce the consumption of chemical fertilizers and prevent soil degradation. Last case study is on eco friendly material and solar energy. Located in Magarpatta city, Pune, Maharastra, which is one of the eco-friendly buildings and is developed by the Magarpatta Township development & construction Ltd.

**6.1 ORCHID HOTEL**

1) CONSTRUCTION OF ORCHID

This has reduced the need for artificial lighting in the lobby, corridors and the rooms that face the atrium, thereby saving on tremendous amounts of energy and thus reducing carbon emissions. Boulevard - The 24 hour Coffee Shop is strategically located around the atrium so as to capture natural light during the day. ROOF TOP The swimming pool is located on the rooftop with 5 feet of water body, which acts as an insulator from the heat. KoolDeck is applied around the swimming pool deck to reduce the glare and the surface temperature so that one can walk barefooted around thepool.

## 2) Construction materials used in making the building green.

**CEMENT :**

The cement that has been used into making The Orchid an eco-friendly Hotel is absolutely environment friendly. This cement, PPC (Portland Puzzolana Cement) contains 15-20% fly ash, as compared to OPC (Ordinary Portland Cement).

**QED (QUITE EASILY DONE):**

We at The Orchid are not guilty of depletinv, the topsoil of the earth! Our internal partitions are made from QED wall panels, which are made from fertilizer waste, instead of the red bricks, which are made from the topsoil of the earth.That's not all, these wall panels are reusable too and will save you from curing, plastering and re curing It is the brick substitute building material of the future having excellent thermal insulationproperties and better sound absorption coefficient than ordinary bricks.

**AAC (AUTOCLAVED AERATED CONCRETE) :** Another environment friendly alternative used by us is AAC. We use this material for our external walling and wet walling structure dour Hotel. AAC is eco-friendly as it manufactured using approximately 60% fly ash.

**Five Globes i.e. points for making it Ecotel.**

1-Solid Waste Management

2-Energy Efficiency

3-Water Conservation and Preservation

4-Environment Commitment

5-Employee Environment Education and Community Involvement

Details of the 'wood' utilized at The Orchid.

RUBBER WOOD (SITI WONDER WOOD) Despite its natural timber look the window frames, master control panel in the guestrooms and shutters are made from Rubber wood.After producing rubber sap and the tree is cut down, the same cannot be used for any constructive purpose, as the wood acquired from the rubber tree is soft. The rubber wood then derived is processed and upgraded wood, which has been vacuum, impregnated using unleachable type of timber preservative chemicals and kiln seasoned to ensure dimensional stability. NUWUD MDF (Medium Density Fibre Wood) The interior works of the Hotel is made from MDF, which is manufactured using cotton stalks. The cotton tree, which grows to a height of 5-6 feet, is cut down after yield and the same is usually rendered useless. With the help of advanced technology, the waste stalks of the cotton tree then goes through a manufacturing process which includes chipping, sieving, washing and cooking of the fiber chips. After this lengthy procedure Medium Density Fibre Wood is produced having all the features of natural wood

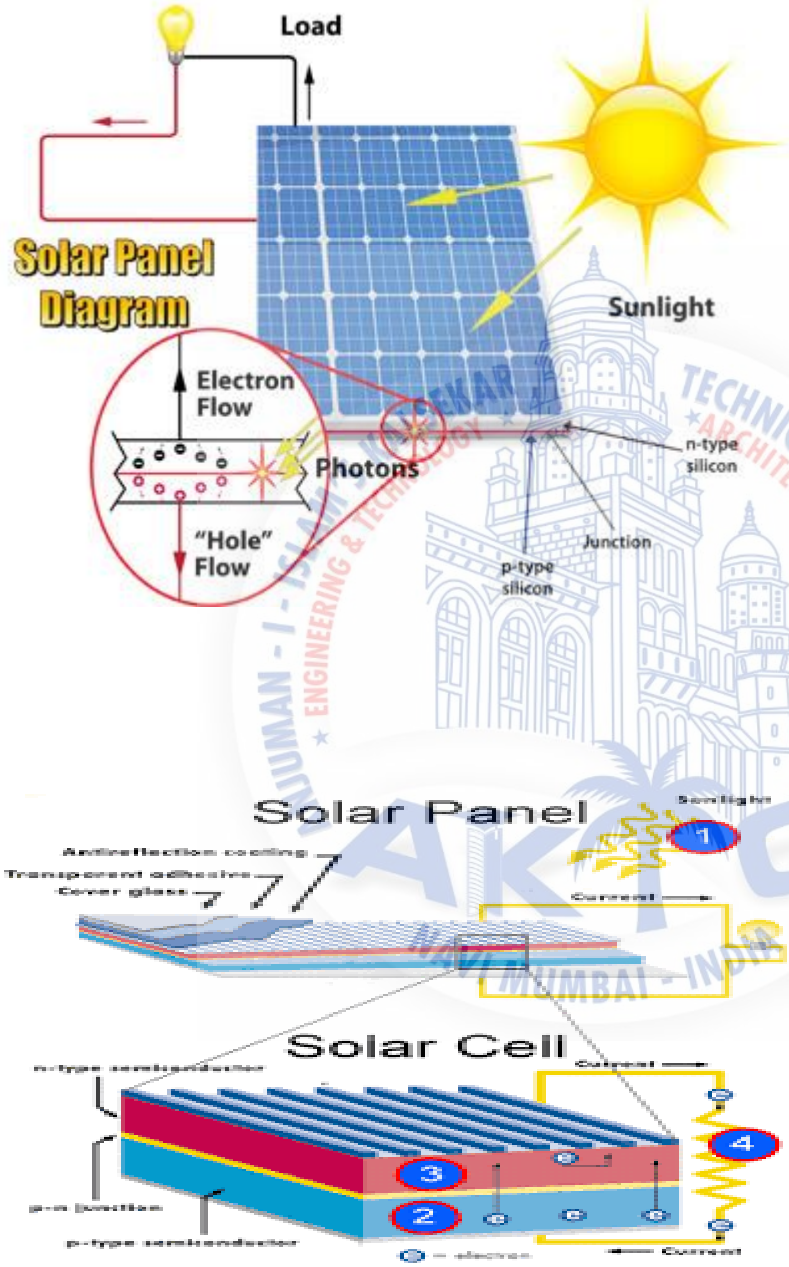
**7) REUSED WOOD**

At the restaurant South ofVindhyas, the entire interiors i.e. the woodwork has been made from wood recycled from old buildings. This concept was specially incorporated keeping our eco-friendly image of the Hotel.
The cost of green buildings depend on various factors-the building program, demographic location, the rating which is being tried to achieve (if at all), how early the green principles have been applied in the project and the competence of the designers with green concepts. Notably, green buildings provide financial benefits that conventional buildings do not; the benefits include energy and water savings, optimal daylight and ventilation (leading to less dependency on mechanical systems), reduced waste, improved indoor environmental quality, reduced operation costs and reduced infrastructure strain.

Additional design analysis, computer modelling, product research and lifecycle cost analysis for alternative materials does require an extra investment in the beginning but through reduced maintenance, utilities, longer life of building materials and a better environment, the returns compensate for the initial investments. Infact in the longer run green buildings can prove to be more economical than conventional buildings. Earlier green projects were costlier due to new methods of design and construction but by 2005-2006, the costs were being lowered to more conventional levels. "A green building certification can raise the cost of construction by Rs.100-400 per square foot." is over the lifecycle of building, shows that green A cost benefit analysis buildings are not only healthier to live in but also cheaper in the long run.

## 5.3 ROSHANI PROJCT AT RASHTRAPATI BHAVAN

1. SOLAR ENERGY



Use of renewable energy sources and conservation of electricity i basic objectives of the roshini pro is one of the gramme. Accordingly, traditional bulbs have been replaced with CFLs. In order to harness the solar energy a 50 KW p SP V power plant consisting of 64 solar panels each consisting of 5 modules has been installed at terrace of the Auditorium building. The power generated is being used for facade lighting of auditorium and lighting of perimeter of football ground from dusk to dawn. In addition 100 Nos. stand alone solar street lights of 2 x 14 watts capacity each have been installed for street lighting an important stretches in Schedule-A and Schedule-B of the President's Estate. The renewable solar light will help to reduce electricity consumption by approx. 54750 KWh per annum which will save power cost by Rs.3.5 lakh per annum.

**2.VERMI-COMPOSTING**

Every month and on the other hand President's Gardens have to incur an expenditure of about Rs.4 to 5 lalchs on procurement of manure, which is not always environment friendly. Therefore, in order to dispose off the garden waste fruitfully and to save expenditure on purchase of manure it was decided that garden waste would be converted into organic manure in the President's Estate. Women of Self Help Group working in the venni-composting pits For thispurpose, 96 vermi-composting pits have been constructed covering an area of 3840 sqlt. in the Dalikhana area of the President's Estate. These pits would consume about 300 cubic metre of garden waste. In addition about 150 cubic metre of horse/cattle dung generated from the President's Stables is also being converted into vermincomposts in these pitS. The pits have been made operational and process of production of organic manure has started with the Self Help Group of the women of the President's Estate. The manure produced will be rich in nutrients like nitrogen, phosphate, potassium and magnesium. This will reduce the consumption of chemi l fertilizers and prevent soil degradation.

President's Estate has a large green area and considerable amount of garden waste is generated

**6.4 MAGARPATTA CITY,PUNE:**


The Magarpatta township development & construction Ltd, They are developed eco-friendly township "MAGARPATTA CITY" is located on the Eastern side of Pune in Maharashtra. It has spread on area of 180 hectares and is planned to accommodate.

a) 7500 residential units.

b) 50 lacs sqft of technology park

c) 20 lacs sqft of commercial offices.

d) A 200 bed hospital.

e) Schools and colleges.

f) Hotels and restaurants.

g) A central garden of 25 acres.

h) A number of smaller gardens ranging from 1 to 4 acres.

i) Having thousands of trees and shrubs.

j) Shopping mall with multiplex. Etc.

The township is trying to become eco-friendly project with the concept of sustainable developments, with the help of,

1. Maximum use of fly ash as a partial replacement of cement without compromising the quality, by using fly ash thus we are reducing the CO2 emissions which are get generated while manufacturing cement

2. Solar water heating systems for hot water for bathing hence reducing the consumption of electricity by residential units by approximately 50 %, which indirectly has helpe in reducing the generation of fly ash..

3. Garbage segregation at source- selling of non degradable materials and using degradable waste to produce manure by vermiculture and biogas.

## STATUS OF FLY ASH CONSUMPTION

BY MAGARPATTA CITY ( TOWNSHIP )

| SR.NO. | DESCRIPTION | QTY. OF FLY ASH IN Mt. |
|---|---|---|
| 1 | Fly ash consumption so far | 28016 |
| 2 | Anticipated prejection of fly ash consumption by the completion of township from now | 80510 |
| 3 | Total anticipated consumption of fly ash from start to completion of township | 108526 |

Consumption of fly ash and using higher volume of fly ash in concrete and in other activities helps in reduction of cost in township projects by over 5% without affecting the quality of work . for project use of fly ash would help in saving approximately Rs. 15 crores.

Use of solar water heating system helps indirectly in reducing the generation of fly ash. They have planned to use approximately 8000 collector panels of solar water heating systems of 125 Liter / day capacity out of which more than 2000 panels have already been installed.

This will result in saving of the following :-
1. 48000 units of electricity per day.
2. 1.53 Crore units of electricity per year.
3. This saving of electricity will help indirectly in reduction of $CO_2$ emission by approximately 12000 tons per year. Partial replacement of cement by fly ash in township
4. Projects will result in, consumption of fly ash in large quantum as discussed in this case study. This contributes towards better and safe environment.

# CHAPTER 7

PHOTO GALLERY

**SOLAR PANELS USED**

**REUSE WOOD USED IN HOTELS**

**VERMICOMPOSTING IN ORCHID HOTEL**

**SAWDUST HANGER USED IN ORCHID HOTEL**

# Operational Practices

**Shopping bags : Provided on request with environment messages.**

**Laundry: Reusable cloth laundry Bags.**

**RECYCLE WATER USE IN GARDEN**

**CLOTH SLEEPERS**

**RECYCLE DUST BIN**

# CHAPTER 8

## A) FUTURE SCOPE OF THE PROJECT

Buildings commercial, industrial and residential account for about 40 per cent of the world's greenhouse gas emissions. Governments everywhere are exploring ways to tackle this. The task involves incorporating energy-efficient measures in various aspects of construction. To ensure India doesn't lag behind, the prime minister's council on climate change cleared the Urban Habitat Mission under the National Action Plan on Climate Change. This will make it mandatory for new office buildings to conform to energy-saving codes in three years' time. Since only 700 buildings have so far implemented these norms, it's clear all builders won't voluntarily go green. This is not surprising, since many tend to flout even basic fire safety norms. The Centre's decision will require states to amend municipal bye-laws to qualify for JNNURM funds.

India's construction industry is growing at an annual rate of over 30 per cent. For this growth to be sustainable, energy-efficiency is a must. This is all the more so given inadequate power and water resources in the country. Though initial investment is high, green buildings mean substantial savings in energy in the long run. Green design norms including use of right materials, appropriate orientation, insulation and shading can help conserve up to 50 per cent of buildings' energy costs. As a developing country, India needs to create urban infrastructure using precious resources in energy-efficient ways. It's already ahead of Australia and close behind the US in adopting green building designs, with future opportunities to export green-building technologies. Finally, the process of certifying green buildings mustn't turn into a regulatory maze that creates scope for corruption. To help tile green building initiative, cut the red tape.

Green buildings are a happy Sign of the times, with a g ar eness on carbon emissions. It doesn't growin aw take much to make a building green: utilize locally available material, make the best use of sunlight and natural air currents, harvest rainwater and recycle corporation water, and manage waste efficiently. The initial infrastructure cost may be a bit steep, but this is offset by low electricity and water bills. If such.green features were to be made mandatory for all new constructions, and incorporated into the sanctioned plans, it would go a long way in cooling our environment and keeping a water famine at bay. Green buildings are fast catching the

imagination of thepeople. Though the penetration level is just around 5%, the Indian Green Building Council (IGBC) is happy the residential sector is coming up with such buildings.

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Going by industry prediction, the residential sector both independent houses and residential apartments are set to outnumber commercial buildings by 2030 in India.
Maharashtra tops the national figure with the highest number of green buildings, followed by the National Capital Region. Tamil Nadu holds third position.

According to figures with IGBC, there are 1,909 registered buildings in the country For the next one year, Grover will be reaching out to 10,000 students of architecture, initiating them to the green cause, calling it the 'Students Green Movement'. The aim of the mission is to encourage the young architects to promote green buildings.

# CONCLUSION

From the data collected and the case studies we conclude the following savings and estimates:

### 8.1 WATER CONSERVATION

Water conservation for Rodas Hotel & Orchid is 293 liter/day & 222 liter/day per thousand sq ft respectively. On an average 257 liter/day of water is saved.

### 8.2 POWER SAVED

Power saved for Rodas Hotel & Orchid Hotel is 7919 kW/year &9000kw/year per thousand sq. ft. respectively. Average power saved per thousand sq ft. is 8459 kw/year. Amount saved on power for Rodas Hotel & Orchid Hotel is Rs.54115/year & Rs.63000/year per thousand sq ft. Average cost saved per thousand sq ft. per year is Rs.58557/year.

### 8.3 AERATORS

Cost of aerators for Rodas Hotel & Orchid Hotel is RS.1.1 lakh & Rs.0.83 lakh per thousand sq ft. Average cost of aerators per thousand is sq ft. RS.0.965 lakh.

### 8.4 ELECTRIC APPLIANCE FOR ENERGY SAVING

Cost of electric appliance for energy saving in Orchid Hotel & Rodas Hotel is Rs.5.86 lakh and Rs.5.27 lakh respectively. Average cost is per thousand sq ft. is Rs.5.5 lakh.

a) CHILLER PLANT

Cost of chiller plant for Rodas Hotel & Orchid Hotel per thousand sq ft. is Rs.1.46 lakh & Rs.0.611 lakh respectively. Average cost of chiller planter thousand sq ft. is Rs.3.25 lakh.

b) CFL & PL LAMPS

A cost of CFL & PL Lamps per thousand sq ft. is Rs.2.27 lakh & Rs.2.22 lakh respectively. Average cost of CFL & PL Lamps per thousand sq ft. is Rs.2.2 lakh.

**8.5 PLUMBING**

Cost of plumbing for Rodas Hotel & Orchid Hotel per thousand sq ft. is Rs.1.46 lakh & Rs.0.61 lakh. Average cost of plumbing per thousand sq ft. is Rs.1.035 lakh. As the modernization and technological advancement are gaining momentum in the self build industry in the world, the eco-friendliness is taking a back seat. The sudden spurt of technological advancement sans care for the nature is doing more harm than good. Actually, the process should be the reverse. We should be more concerned about the environment by constructing environmentally friendly and sustainable structures. In response to growing awareness of the building environment's effect on the natural environment, architects and builders, activists and government agencies are increasingly championing an alternative method of designing and construction. It's an approach called Green building. The essence of green building is creating structures that are far more efficient in their consumption of energy and water and less wasteful in their use of materials than conventional buildings. Once a movement on the architectural fringe, green design principles are starting to appear in everything from a new generation of government buildings and corporate offices to single family homes and apartment complexes. Green building can often cost more than conventional construction. But proponents say higher up-front costs will pay for themselves in the long run. A recent study reports that 2 percent additional cost in a green building's design translates into savings of up 20 percent in energy costs over the life span of the building. And all these combine to make a more comfortable, more effective to operate, and yet highly cost-effectively space. Thus, in all, it can be said that Construction of Eco-friendly Structures has become the need of the day.

## B) RECOMMENDATIONS:

A pre-occupied building can also be converted as green building just by installing few of the affordable components with a very few payback period in order to be so called as "Green Building". Though the certification to be provided depends on the extent to which the replacement are being done.

For small houses and flats atleast initiation should be taken of installing the CFL and PL lamps, inorder to bring down the electricity consumption.
For societies and some commercial building, often renovation plans are being prepared. During this renovation period they can plan for opting of installing units like Rain water harvesting, Solar panels or solar operated lightings in the premises etc. Further if any new civil work is to constructed, it should be done in Greener method such as instead of bricks porous cement blocks can be made use of.

# CHAPTER 9

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