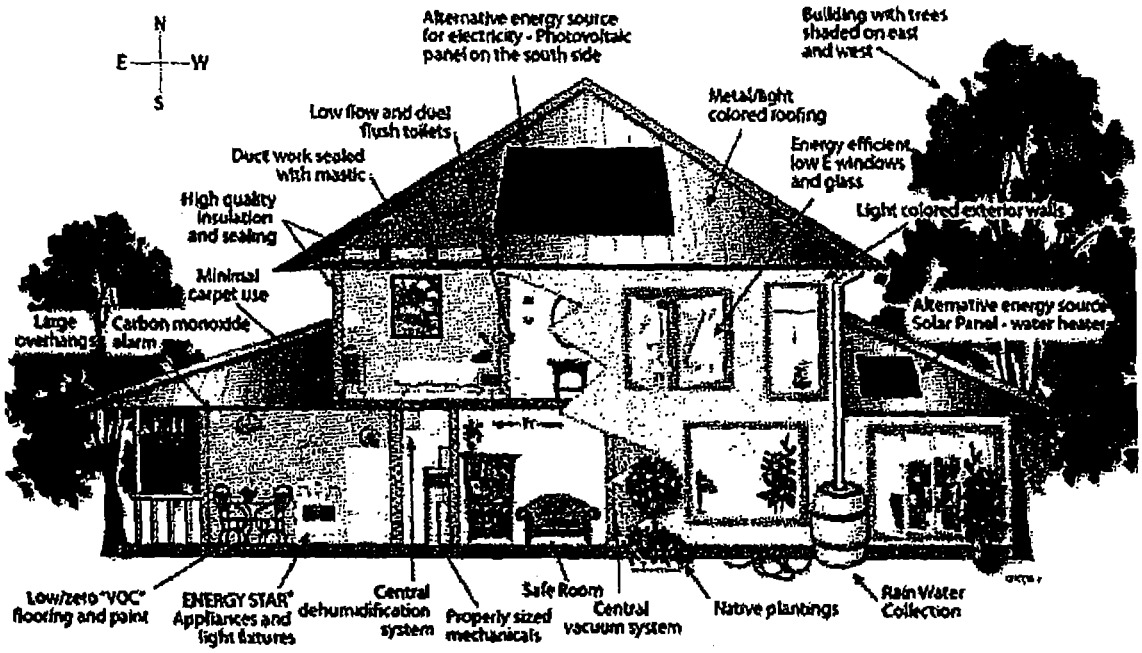
4th civil
GB

UNIT - 1

INTRODUCTION:

- The Built Environment has profound Impact on our Natural Environment, Economy, Health and Productivity.
- Green Building can Design, Build and Operate a Building that Delivers High Performance Inside and outside.
- Building annually consumes more than 20% of electricity used in India.
- Green Building practices can substantially reduce or eliminate negative environmental impacts and can improve existing unsustainable design, construction and operational practices.
- Green Building reduces Operational costs, enhances Building marketability, Increase worker productivity, Improves Indoor Environment Quality, and Reduces potential liability resulting from Indoor Air Quality problems.
- People Friendly GREEN Building design gains productivity by 16%, Reduction in Absenteeism and improved work quality, which benefits building stakeholders, including owner, occupants and general public.
- In development circles, Green has gone from a boutique idea to a mandatory part of the Architecture and Construction.
- Almost all Construction waste is recycled or reused.
- Green Buildings consumes about 25% less energy than conventional buildings.
- In Green Buildings Interiors are done with low V.O.C. content materials, adhesives, sealants, paints and carpets, which reduces allergies and illness.



Green Buildings: Controls erosion to reduce negative impacts on water and air quality.

- Avoid development of inappropriate sites and reduce the environmental impact.
- Channel development to urban areas with existing Infrastructure, protect green fields and preserve habitat and natural resources.
- Rehabilitates damaged sites where development is complicated by real or perceived environmental contamination, reducing pressure on undeveloped land.
- Reduce pollution and land development impacts from automobile use.
- Conserve existing natural areas and restore damaged areas to provide habitat and promote biodiversity.
- Limit disruption of natural water hydrology by reducing impervious cover, increasing onsite infiltration and managing storm water runoff.
- Limit disruption of natural water flows by eliminating storm water runoff, increasing onsite infiltration and eliminating contaminants.
- Reduces Heat Islands to minimize impact on microclimate and human habitat.

- Minimize light trespass from the building and site, reduce sky-glow to increase night sky access, improve nightmare visibility through glare reduction.
- Limit or eliminate use of potable water for landscape, irrigation air conditioning make up.
- Reduce the generation of waste water and potable water demand, while increasing local aquifer recharge.
- Reduce Ozone depletion.
- Increase demand for building products that incorporated recycled content materials, therefore reducing impacts resulting from extraction and processing of new virgin materials.
- Reduce the use and depletion of finite raw and long cycle renewable materials by replacing them with rapidly renewable materials.
- Provide a comfortable thermal environment that supports the productivity and well-being of building occupants.

Typical Features of Green Building

Sustainable Development: Present Site Condition

- Site Development—Protect & Restore habitat—Maximize Open space
- Heat Island Effect—Roof & Non Roof
- Basic Amenities
- Parking
- Transportation & Alternate Transportation
- Design for Differently Able
- Storm water design— Quality & Quantity control
- Development Density & Community Connectivity
- Light Pollution Reduction

- Green Home Guidelines—-Design & Post occupancy

Water Efficiency: Water Efficient Landscape

- Innovative waste water technologies
- Gray water treatment
- Use of treated Gray water
- Water Use reduction
- Ground water recharge
- Roof rain water recharge / harvesting
- Rain water harvesting
- Water efficient fixtures

Energy Efficiency: Passive Cooling System

- Passive ventilation System
- Energy in Building Construction
- Advanced Windows & Energy Savings
- Fundamental Building System Commissioning
- Enhanced Building System Commissioning
- Minimum Energy Performance } MEPS
- Optimize Energy Performance }
- Active Energy Efficiency
- CFC reduction in HVAC Equipment
- Fundamental Refrigerant Management
- Enhanced Fundamental Refrigerant Management
- Building Energy simulation
- Building Envelope Design

- On-site Renewable Energy
- Hybrid Energy
- Building Integrated renewable Energy technologies
- Measurement & Verification
- Building Automation & Control
- Green Power

Materials & Resources Storage & Collection of Recyclables

- Building Reuse
- Construction Waste management
- Material Use
- Regional Material
- Rapidly renewable Materials
- Certified Wood

Indoor Environmental Quality : Minimum Indoor Air Quality Performance

- Outdoor Air Delivery Monitoring
- Increased Ventilation
- Low Emitting Building Materials
- Control ability of Systems—Light & Thermal Comfort
- Thermal Comfort Design & Verification
- Daylight & Views—Daylight
- Daylight & Views—Views

Innovation In Design Process : Vastu Principles

- Bio dynamic Farming

- Three tier Cooling System
- Three grade Cooling System
- A pert of building to be Net Zero
- Zero Discharge
- Geo Thermal Cooling
- Wind Towers
- Bio-fence
- Thermal fence
- Green Walls
- Hydroponics

Regional Priority Energy Conservation

- Water Conservation
- Disaster Management Plan
- Meditation Room
- Environmental Tobacco Smoke Control

- **Definition:** Green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building is also known as a sustainable or high performance building.

(or)

A **Green building** is one which uses less water, optimizes energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants, as compared to a conventional building.

- **Why go green:** Now, let us take a look at why it is so important to go green. Most people will find when going green that they are able to reduce their carbon footprint and actually lend a helping hand to the environment. You can go green in a variety of different ways, but builders and construction workers must do their part as well. If you haven't begun going green, then you will find that there are a variety of different things that you can do to help you get started. You don't have to jump in head first, and you can actually take some baby steps along the way. Green buildings are designed in such a way to reduce overall impact on environment and human health by,

1. Reducing trash, pollution and degradation of environment.
2. Efficiently using energy, water and other resources.
3. Protecting occupant health and improving productivity.

- **Does going green really cost more**: Some people feel that they just can't go green because it will cost them more money, but that is really a common misconception. While it may cost you a bit more to get started when you are going green, because green materials and products can be more costly, you really have to consider the type of savings that you will be able to reap. You will be able to save on energy costs, because

going green also means conserving energy. You should really look at the green building as more of an investment than anything else. An investment that will be able to save you money, as well as an investment that will be able to help the environment! It is a win-win situation for everyone.

- **Benefits of green building:** With new technologies constantly being developed to complement current practices in creating greener structures, the benefits of green building can range from environmental to economic to social. By adopting greener practices, we can take maximum advantage of environmental and economic performance. Green construction methods when integrated while design and construction provide most significant benefits. Benefits of green building include,

1. Environmental benefits:

- Reduce wastage of water
- Conserve natural resources
- Improve air and water quality
- Protect biodiversity and ecosystems

2. Economic benefits:

- Reduce operating costs
- Improve occupant productivity
- Create market for green product and services

3. Social benefits:

- Improve quality of life
- Minimize strain on local infrastructure
- Improve occupant health and comfort

► **Sustainable Site Selection:** There should be easy availability of public transport and conveniences so as to cut down energy consumption for transportation. A suitably selected site thus gets the benefit of mass transit.

Also, rehabilitation of sites damaged by environmental contamination is a better option than any new piece of land where large amount of energy and resource is needed to make the land worthy of building on. Rehabilitation thus saves large amount of energy.

Already existing landscape, soil and natural features should be protected. For this reason, hard paving on the site should be avoided to preserve top soil and ease rain water harvesting. There should be minimum storm water runoff.

► **Material and Resources:**

- Sustainable construction material are chosen keeping in mind various characteristics like zero or low toxicity, high recyclability, zero or low off gassing of harmful air emissions, durability, reused and recycled content, sustainably harvested material. Dimensional planning and other material efficiency strategies are used to reduce the construction costs.

- Construction and demolition material can be reused and recycled for e.g. inert demolition material can be used as base course for landfills. Proper planning for managing materials through deconstruction, demolition and construction is done. Efficient planning of utilities to minimize

- Utilization of rapidly renewable materials, such as bamboo flooring, wool carpets, strawboard, cotton ball insulation (made from denim scrap), genuine linoleum flooring, or poplar oriented-strand board (OSB). Using rapid renewable helps reduce the use and depletion of finite raw material.

- Use of materials that are available locally is preferred over materials that need to be brought from distant places. It saves transportation costs. Also, alternative materials that

can be generated from waste with lesser energy is used over conventional building materials.

- For example, alternative materials for timber like MDF board, Mica Laminates and Veneers on composite boards should be used instead of natural timber. Industrial waste based bricks and blocks, aerated lightweight BPC concrete blocks, Phospho-Gypsum based blocks can be used for masonry structures. Fly ash, for bricks, outdoor paving and in concrete.

► **Water Efficiency:**

- Installation of water efficient or low flow equipments in kitchens and bathrooms to reduce water consumption.

- Incorporating waste water management technologies like dual plumbing for using recycled water in toilet flushing or using water conserving fixtures such as low flow shower heads, self closing nozzles on hoses, water closets with dual flush options.

- Use of Micro irrigation techniques at sites instead of high pressure sprayers.

- Recirculation system for centralized hot water distribution.

- For landscaping purpose, local plants and trees are used as they consume less water.

- Provisions for reusing and recycling water are made to ensure efficient water management.

- Using treated waste water, non potable water for site irrigation. Raw sewage can be recycled using aquatic plants like duckweed and water hyacinth to produce clean water suitable for re-use in irrigation and industry.

- Integrating Rain water harvesting system in building design to ensure maximum possible utilization of rain water.

- **Materials efficiency:**

  Building materials typically considered to be 'green' include lumber from forests that have been certified to a third-party forest standard, rapidly renewable plant materials like bamboo and straw, dimension stone, recycled stone, recycled metal (see: copper sustainability and recyclability), and other products that are non-toxic, reusable, renewable, and/or recyclable. For concrete a high performance or Roman self-healing concrete is available. The EPA (Environmental Protection Agency) also suggests using recycled industrial goods, such as coal combustion products, foundry sand, and demolition debris in construction projects. Energy efficient building materials and appliances are promoted in the United States through energy rebate programs.

- **Concept of Green Building**

It mainly concentrates mainly on two points:

- Increasing the efficiency with which buildings use energy, water and materials
- Reducing building impacts of human health and the environment, through better site selection, design, construction, operation, maintenance, and removal throughout the complete life cycle.

- **What is Sustainability**

  Sustainability can be defined as the practice of maintaining processes of productivity indefinitely—natural or human made—by replacing resources used with resources of equal or greater value without degrading or endangering natural biotic systems.

  (or)

  "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

  (or)

  A process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony

and enhance both current and future potential to meet human needs and aspirations" The World Commission on Environment and Development

(Or)

"Sustainable development is a dynamic process which enables people to realize their potential and improve their quality of life in ways which simultaneously protect and enhance the earth's life support systems".

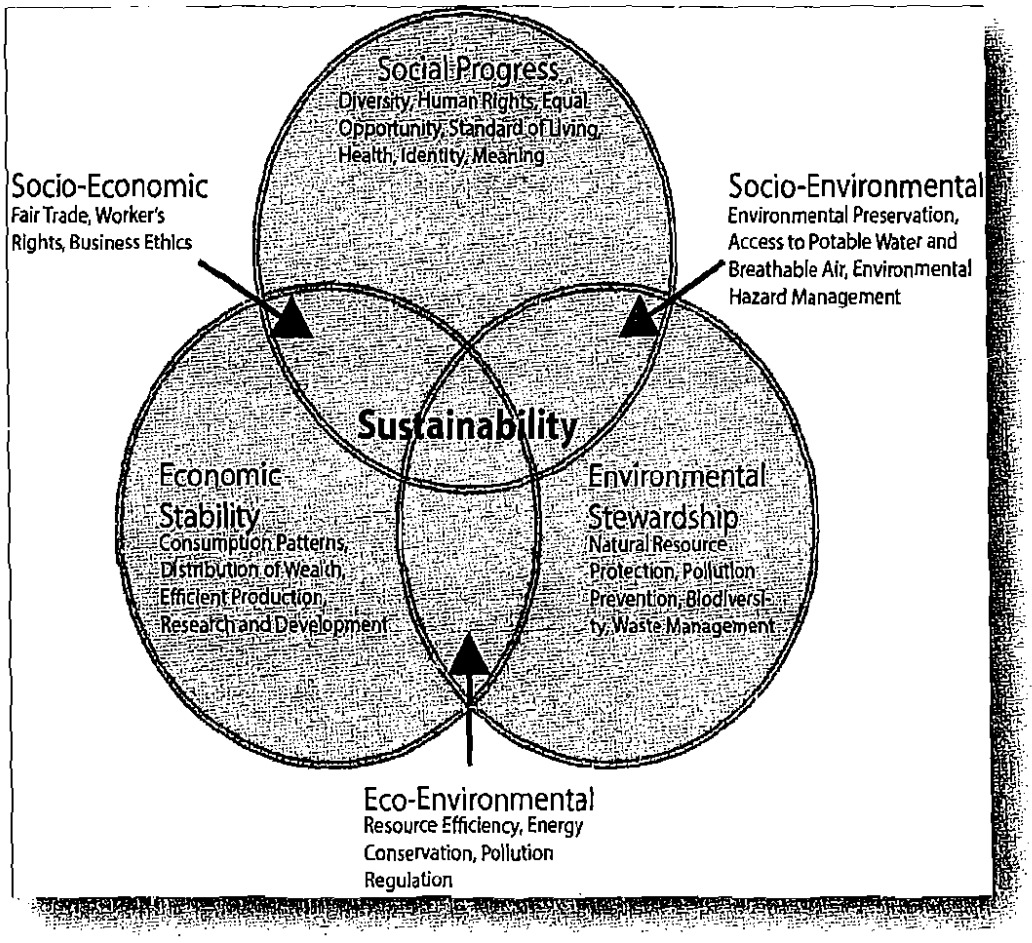
▶ **Key Principles of Sustainable development:**

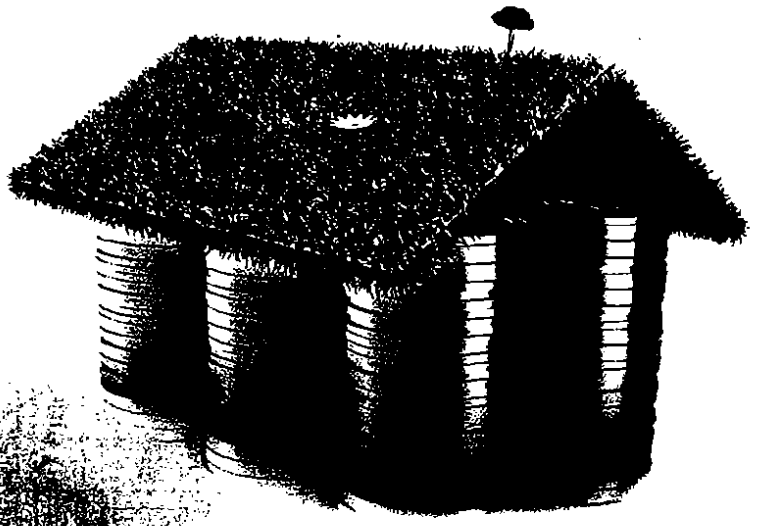
"In essence sustainable development is about five key principles:

- Quality of life
- Fairness and equity
- Participation and partnership
- Care for our environment and respect for ecological constraints
- Recognizing there are 'Environmental limits' and thought for the future

"The environment must be protected... to preserve essential ecosystem functions and to provide for the wellbeing of future generations; environmental and economic policy must be integrated; the goal of policy should be an improvement in the overall quality of life, not just income growth; poverty must be ended and resources distributed more equally; and all sections of society must be involved in decision making".

"A sustainable future is one in which a healthy environment, economic prosperity and social justice are pursued simultaneously to ensure the well-being and quality of life of present and future generations.


Social Progress
Diversity, Human Rights, Equal Opportunity, Standard of Living, Health, Identity, Meaning
Socio-Economic
Fair Trade, Worker's Rights, Business Ethics
Socio-Environmental
Environmental Preservation, Access to Potable Water and Breathable Air, Environmental Hazard Management
Sustainability
Economic Stability
Consumption Patterns, Distribution of Wealth, Efficient Production, Research and Development
Environmental Stewardship
Natural Resource Protection, Pollution Prevention, Biodiversity, Waste Management
Eco-Environmental
Resource Efficiency, Energy Conservation, Pollution Regulation



Green buildings are energy-efficient

The formation of GRIHA as the National Rating System of India is a pioneering step towards promoting the green building concept in India

The Centre for Environmental Sciences and Engineering (CESE) building at the Indian Institute of Technology (IIT), Kanpur became the first building in India to be awarded five-star Green Rating for Integrated Habitat Assessment (GRIHA) rating by TERI in 2009. The research facility constructed on 1,75,000 square metres of plot at the IIT Kanpur is fully compliant with the Energy Conservation Building Code (ECBC) which houses laboratories, seminar

> In order to cut down on energy usage, one must think of various measures during construction and renovation of the buildings.

rooms, and discussion rooms. The CESE building is a clear example of how energy efficiency and environmental conservation rely on renewable energy measures in an era of growing concern for energy independence and limited carbon emissions.

Of late, discussions have centred around how Green Buildings can meet environmental goals with minimum use of energy. The formation of GRIHA, as the National Rating System of India is a pioneering step towards promoting the green building concept in India.

The green building concept

Green buildings are structures designed with an environmentally responsible and resource-efficient approach throughout the structure's lifecycle: right from selecting a site to design, construction, operation, maintenance, renovation, and demolition. The green building concept takes into consideration the practices that would enhance the living standards of the occupants in an environment-friendly atmosphere with minimum harm to the environment.

Basically, a green construction or sustainable building uses an optimum amount of energy, consumes less water, conserves natural resources, generates less waste and creates spaces for healthy and comfortable living. Various benchmarks attest whether a building qualifies for a green tag.

Need for green buildings

The design, construction, and maintenance of buildings have a tremendous impact on our environment and our natural resources. Traditional building practices often overlook the interrelationships between a building, its components, its surroundings, and its occupants; and consume more of our resources than necessary, negatively impacting the environment. The basic resources like ground cover, forests, water, and energy are depleted to construct and operate buildings. This is where green buildings step in with an aim to address all these issues in an integrated and scientific manner.

Speaking at a conference on "Energy Efficiency in Buildings" in New Delhi, Dr B Bandopadhyay, Advisor, MNRE said: "Nothing can be achieved without energy, and in order to cut down on energy usage, one must think of various measures during construction and renovation of the buildings. We are at a time where climate-responsive buildings are the need of the hour." He stressed the need to go in for energy-efficient windows and to design buildings that facilitate ample daylight and ultimately minimise energy consumption.

B V Rao, General Manager (TS), IREDA said: "Due to economic development, people have doubled the use of ACs and other energy-intensive electronic gadgets. Though a number of energy efficiency measures, like mandating the use of the Star-rated electronic goods, have been introduced in the last decade, a lot more needs to be done. IREDA plans a lot of incentives for those who opt for the construction of green buildings leading to energy conservation."

Benefits of a green building

Green building practices aim to reduce the environmental impact of new buildings by promoting resource conservation. They create a healthy and comfortable environment; reduce operation and maintenance costs; and address issues such as heritage conservation, access to public transportation and other community infrastructure systems.

Energy codes define the minimum acceptable standards for a climate

> The basic idea behind the implementation of GRIHA is ro reduce up to 30 per cent energy consumption.

zone. Considering the statistics, reducing the amount of natural resources buildings consume and the amount of pollution given off are all crucial for future sustainability. Hence, smart thinking and adequate polices are required in constructing new buildings in such a way that they use a minimum of non-renewable energy, produce the least pollution, and are cost-effective, while increasing the comfort, health, and safety of occupants who live and work in them.

In sum, a building may be considered 'Green' if it follows:

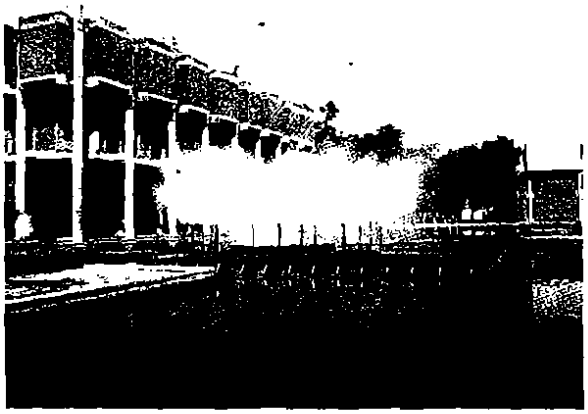
- Proper site planning
- Building envelope design
- Building system design for HVAC (heating ventilation and air conditioning), lighting, electrical and water heating
- Low operation and maintenance costs
- Integration of RE sources to generate energy onsite
- Good water and waste management
- Selection of ecologically sustainable materials with low emission potential
- Indoor thermal and visual comfort and air quality leading to less energy consumption
- Proper access to community infrastructure systems

It is a fact that the green building processes lead to an increase in the overall cost of construction, however, it is also a proven fact that it costs less to operate a green building that has tremendous environmental benefits and provides a better place to work and live in. The green buildings will no doubt prove to be profitable venture not only for its occupants but also for the environment as a whole if the prescribed norms and principles are strictly followed.

National Rating System of India

GRIHA (Green Rating for Integrated Habitat Assessment) is the National Rating System of India launched in 2008. It has been conceived by The Energy and Resources Institute (TERI) and developed in collaboration with the Ministry of New and Renewable Energy (MNRE), Government of India. It is a green building 'design evaluation system', and is suitable for all kinds of buildings in different climatic zones of the country. The basic idea behind the implementation of a rating system like GRIHA is to reduce up to 30 per cent energy consumption, with limited waste generation due to recycling, less consumption of water, and reduced pollution load & liability. CPWD adopted GRIHA as Green Building Standard in 2009, and the Government of India in 2010 made GRIHA 3 star mandatory for government buildings.

There are a set of 34 criteria formulated by GRIHA to a rate a green building. A minimum amount of renewable energy is mandated for a building to be rated under the GRIHA scheme. GRIHA follows a star-rating system wherein the buildings are rated from 1 star to 5 star status pertaining to scoring points set under various guidelines. Informing about the projects undertaken by GRIHA, Siva Kishan, CEO, Adarsh (GRIHA), said that as of January 2011, GRIHA is working on 108 projects among which 73 are government projects. These 108 projects account for a total of 10 crore sq m of buildup area, and in the near future the number of projects are likely to reach 250. He said that five projects have already been star rated – The CESE building at IIT Kanpur (5 star), Suzlon One Earth based in Pune (5 star), PTS



> An average Indian buyer prefers to go for a cheaper accommodation rather than opting for an energy efficient building.

Tasgaon, Sangli (4 star), Fortis Hospital, Shalimar Bagh, New Delhi (3 star), and Hindustan Unilever building, Mumbai (2 star).

Apart from the five projects that have been rated by GRIHA, the Commonwealth Games village in New Delhi will soon come into the star-rated category. Siva Kishan said that almost all the buildings are covered under that TERI GRIHA rating, except for factory buildings which are difficult to benchmark. When asked about rating smaller projects like flats and small residential and business structures under GRIHA scheme, Mr Siva informed that GRIHA will soon be coming out with a simpler web-based version which will enable the owners to download the guidelines and follow accordingly to meet the green building requirement and rate themselves. In case an owner wants to get certified, a certificate of merit will be issued by GRIHA after evaluating the building as per its benchmarks.

The challenges in India

The Indian building industry is highly disorganised with different people and/or groups engaged in design, construction, equipment provision, installation, and renovation working together. Each group may be organised to some extent, but there is limited interaction among the groups, thus disabling the integrated green design and application process.

Highlighting the challenges in Indian context, Dr Ajay Mathur, DG, Bureau of Energy Efficiency (BEE), opined: "In India there is the problem of split incentive. There is a huge disconnect between builders and the buyers, and to overcome such a situation what is required is a common platform. Also, lack of awareness about renewable and energy efficiency measures in buildings prevails in the country. Market needs to be created in India with proper training so that aspirations are met at the lowest cost. With proper implementation of energy efficiency measures, an estimated 30-40 per cent of energy cost could be minimised."

Answering a question about the biggest hurdle that prevails in India in implementing green buildings, Siva Kishan said: "India is a developing economy, and when it comes to buying residential properties, the initial cost rules the minds of the buyers. An average Indian buyer prefers to go for a cheaper accommodation rather than opting for an energy-efficient building with good light, good water and waste management, toxin-free paint, integrated renewable energy sources etc. The consumers need to be made aware that after a certain period of time the savings outweigh the initial cost."

Hence, taking into consideration the prevailing scenario in India, it is very important to define and quantify sustainable building practices and their benefits. It is also an issue of prime importance to segregate the role of different key players in ensuring that there is a mix of both qualitative and quantitative criteria. It is very important that the building consumes minimal resources over its entire life cycle and leaves behind a minimal environmental footprint. Hence, the guidelines of GRIHA will come in handy in such a scenario, which have been developed after a thorough study and understanding of the current internationally accepted green building rating systems and the prevailing building practices in India. With a number of incentive programmes being launched by IREDA, GRIHA, MNRE and other organisations towards promoting green buildings in the country for a safer and sustainable environment, the future seems encouraging!

WHAT IS GREEN BUILDING:

It is a practice of increasing the efficiency with which buildings use resources like energy, water and materials. It aims at reducing building impacts on human health and the environment by improving the building life cycle — siting, design, construction, operation, maintenance and removal. Sustainable design, green architecture and natural building are similar concepts. Green buildings are more than just a random collection of environmental technologies. They require systemic attention to the full life cycle impacts of the resources embodied in the building and to the resource consumption and pollution emissions over the building's complete life cycle.

Green building practices have been adopted in Australia, Canada, Germany, India, Israel, Malaysia, New Zealand, the United Kingdom and the United States