18MEO103T – Energy systems for Buildings

Unit 5 - Green buildings

What is Green Building?

A Green Building, also known as a sustainable building, is a structure that is designed, built, renovated, operated, or re-used in an ecological and resource efficient manner.

Objectives of a Green Building

- Protecting occupant health,
- Improving employee productivity,
- Using energy, water and other resources more efficiently,
- Reducing overall impact to the environment,
- Optimal environmental and economic performance,
- Satisfying and quality indoor spaces.

Certification available for green buildings:

In India, three certifying agencies are the most popular, and they certify buildings under the names:

- Leadership in Energy and Environmental Design (LEED),
- Green Rating for Integrated Habitat Assessment (GRIHA),
- Indian Green Building Council (IGBC) ratings.

RATING SYSTEM

- *BREEAM*
  - Building Research Establishment's Environmental Assessment Method
  - developed in United Kingdom in 1990
- *LEED*
  - Leadership in Energy and Environmental Design
  - developed and piloted in the US in 1998
  - LEED-INDIA developed in 2006
- *CASBEE*
  - Comprehensive Assessment System for Building Environmental Efficiency
  - Developed in Japan, in 2001
- **GRIHA**
  - Green Rating for Integrated Habitat Assessment
  - By TERI (The Energy and Resources Institute) in India in 2005

Site and landscape planning for green building ensures the following objectives:

1. Minimum disruption of the site
2. Landscaping in an Appropriate way
3. Maximum usage of microclimate features

Site Planning for Green Building

Sustainable site planning is followed in green building construction. These involve the following features.

1. Planning

A collaborative approach is followed where the owners, engineers, architects, contractor and important stakeholders to bought together to develop a sustainable design process. This helps to combine valuable inputs from different expertise.

2. Site Plan

The sustainable site plan is developed based on the discussions and inputs. A sustainable site plan of green building construction is the plan that has less impact on the environment while meeting the project goals of the client. The site plan must fit to the project parameters without compromising environmental concerns.

3. Site Selection

Important parameters to be considered while selecting site are:

The site must not fall under the disaster zone. Flood plain areas must be avoided.

If the building is to be constructed around water bodies, buffers of undisturbed soil must be provided.

Ease of transportation of resources for construction purpose must be kept in mind. The site accessible to public and other means of transportation is a good choice.

Ensure that basic amenities such as bank, child care , post office , park , library , primary school , clinic and community hall are near to or within the site premises .

4. Site Layout

Following parameters are considered while siting and orienting building.

- **The plan is elongated along East/West axis**
- **Exposures to north and south are good for daylighting**
- **Windows must not be provided facing east and west**
- **The most populated area must be oriented towards the north or south direction.**

5. Reduce Impervious Surfaces of Site

Site imperviousness can be reduced by the following methods:

- **Implementing green roofs**
- **Placing plants around parking areas**
- **Implementing permeable pavement options**

Landscaping for Green Building

Landscape design is ignored in the planning stage. There are many benefits a sustainable landscape design can provide beyond the aesthetics of the site. Good landscape design is an effective microclimate modifier. A good landscape design provides shading for the outdoors which is one way of modifying microclimate. It helps to modulate the airflow within the building. Improperly designed landscape consumes a large amount of potable water for its maintenance. Some important parameters to be considered for landscape planning for green building construction are:

- The landscape is placed to directly receive the runoff and captured water
- The landscape is placed and designed such that it filters and cleans storm water
- Provide site rain gardens in parking areas
- Instead of constructing retention ponds, bio-retention ponds can be employed

Benefits of green building.

Environmental benefits

- Enhance and protect biodiversity and ecosystems
- Improve air and water quality
- Reduce waste streams
- Conserve and restore natural resources
- Minimize global warming

Economic benefits

- Reduce operating and maintenance costs
- Create, expand, and shape markets for green products and services
- Improve occupant productivity
- Minimize occupant absenteeism
- Optimize life-cycle economic performance
- Improve the image of the building
- Reduce the civil infrastructure costs

Social benefits

- Enhance occupant comfort and health
- Heighten aesthetic qualities
- Minimize strain on local infrastructure
- Improve overall quality of life

A building can be made ‘green’ by including a variety of characteristics.

Energy, water, and other resources are used in a more efficient manner.

Solar energy – renewable energy resource.

Measures to reduce pollution and waste, as well as reuse and recycling opportunities

The air quality indoors is good.

Non-toxic, ethical, and sustainable materials are used.

The environment is taken into account during the design, building, and operation of the facility.

In design, building, and operation, take into account the residents’ quality of life.

A design that allows for changes in the environment adaptation.

LEED (Leadership in Energy & Environmental Design)

The LEED (Leadership in Energy & Environmental Design) green building certification system is the accepted program all over the world for rating the design, construction and operation of green buildings which is given by The United States Green Building Council (USGBC) since 1998 that aims to reduce greenhouse gas emissions and contribute a healthy living and work environment for residents and workers by using energy efficiently.

The rating systems can be changed for specific building typologies, sectors, and project scopes.

- LEED certifications are awarded according to the following scale (0-100) :
  - **Certified** (40–49 points),
  - **Silver** (50–59 points),
  - **Gold** (60–79 points),
  - **Platinum** (80 points and above).

As the above graphic shows, the LEED certification levels are:

- Certified: 40 – 49 points earned
- Silver: 50 – 59 points earned
- Gold: 60 – 79 points earned
- Platinum: More than 80 points earned

GREEN BUILDING MATERIAL - Overall material/product selection criteria:

It varies as per the project

1. Project is new construction or renovation of the existing building
2. Low toxicity
3. Minimize emission
4. Recycled content
5. Resource Efficient
6. Recyclable
7. Reusable
8. Sustainable
9. Durable
10. Moisture resistant
11. Resource efficiency
12. Energy efficient
13. Water conservation
14. Affordable material
15. Environmental score
16. Minimal chemical emissions

GREEN BUILDING MATERIAL

1. Fly ash(brick wall)
2. Reuse from waste-Old plumbing, doors
3. Wool bricks-More strength than burnt brick, Resistant to the cold and wet climate
4. Clay red mud burnt bricks
5. Sustainable concrete
6. Solar tiles
7. Paper insulation
8. Bamboo –Using bamboo to replace the steel bar
9. Bamboo/timber mat-based walls
10. Cork Flooring
11. Recycled carpeting
12. Pressed Wood
13. Glass
14. Steel(ferrous)
15. Non-ferrous
16. Brick
17. Cardboard
18. Wood, plywood
19. Concrete
20. Autoclaved aerated concrete (AAC)

Green Homes Rating System to address the National priorities. By applying IGBC Green Homes criteria, homes which are sustainable over the life cycle of the building can be constructed. This rating programme is a tool which enables the designer to apply green concepts and criteria, so as to reduce the environmental impacts, which are measurable.

Green buildings ratings for certification:

Green building rating system is a tool which enables the designer to apply green concepts and criteria, so as to reduce the environmental impacts, which are measurable.

IGBC has developed the following 9 green building rating systems in India:

i. IGBC Green Homes
ii. IGBC Green New Buildings
iii. IGBC Existing Buildings
iv. IGBC Green Townships
v. GBC Green Factory Buildings
vi. IGBC Green SEZ
vii. IGBC Green Schools
viii. IGBC Green Landscaping
ix. IGBC Green Mass Rapid Transit System

IGBC Green Homes is the first rating programme developed in India, exclusively for the residential sector. Green homes can have tremendous benefits, both tangible and intangible. The most tangible benefits are the reduction in water and energy consumption right from day one of occupancy. The energy savings could range from 20 - 30 % and water savings around 30 - 50%. Intangible benefits of green homes include: enhanced air quality, excellent daylighting, health & well being of the residents, safety benefits and conservation of scarce national resources. Green Homes rating system can also enhance marketability of a project.

LEED Rating System For Different Building Types

The LEED system encompasses 10 categories of rating systems that are in the field of design, construction, homes, and operation of buildings and neighborhoods.

The 10 systems are:

1. The LEED system for Green Building Design and the Construction

This will include four categories:

a. LEED system for New Construction
b. LEED system for Core and Shell
c. LEED system for School Buildings
d. LEED system for New Construction and Renovations on a major scale
e. LEED system for Healthcare

2. The LEED system for Green Interior Design and the Construction

This will include two categories:

a. LEED system for Interior Works on a Commercial Scale
b. LEED system For Retail: Interior works on Commercial Scale

3. The LEED system for Green Building Operation and Its Maintenance

This includes a single category of LEED system for the Operations and Maintenance of the Existing Building

4. The LEED system for the Green Neighborhood Development

5. The LEED system for Green Home Design and Construction.

Leadership in Energy & Environmental Design criteria

Sustainable Sites

- Stormwater management & erosion control
- Location / site selection
- Alternative transportation
- Habitat
- Microclimate
- Light pollution

58% stormwater retained & infiltrated on site

Energy & Atmosphere

- Performance measurement &Verification
- Energy efficiency
- Renewable energy
- Ozone depletion

Energy performance 24% better than code

Water Efficiency

- Water efficient landscaping
- Beneficial water reuse

Rainwater harvested for irrigation & toilet flushing

Materials & Resources

- Recycle
- Recycled-content
- Reuse
- Regionally manufactured
- Rapidly renewable
- Certified wood

Recycled 86% of construction & demolition waste

Indoor Environmental Quality

- Construction management
- Source control
- Low-emitting materials
- Monitoring
- Ventilation
- Thermal comfort
- Daylight & views

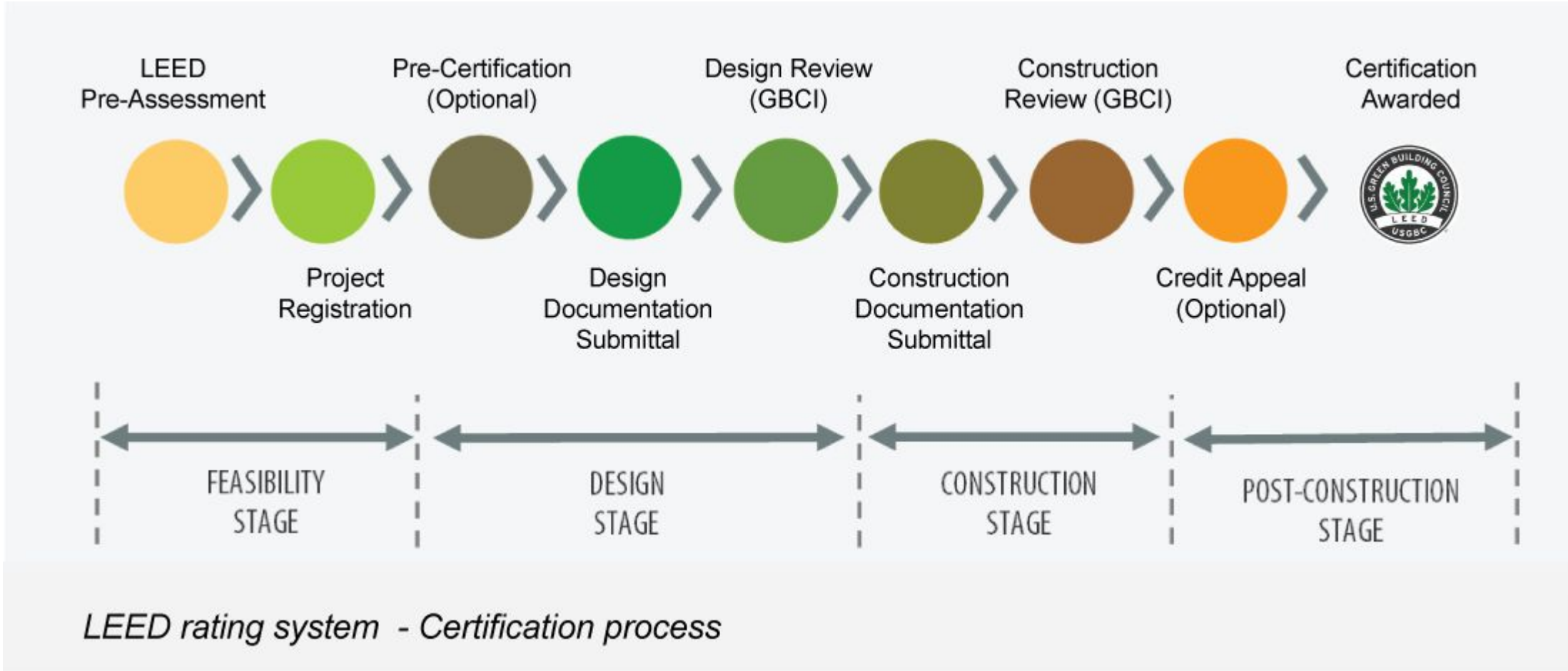
Providing a healthy environment

Innovation & Process

- Innovation in design
- LEED Accredited professional

Exceptional building recycling program – 60% recycling rate

LEED certification process



LEED rating system - Certification process

LEED Certified
40-49 points

Silver Certification
50-59 points

Gold Certification
60-70 points

Platinum Certification
80+ points

Green Globe building assessment protocol

- A confidential online questionnaire allows users to generate a report about property attributes.
- This report assesses the project and determines guidance for best practices during each stage of development.
- The report contains scores from each of the seven categories, as well as strengths, weaknesses, suggestions for improvement, and links to additional resources for enhancing the project.

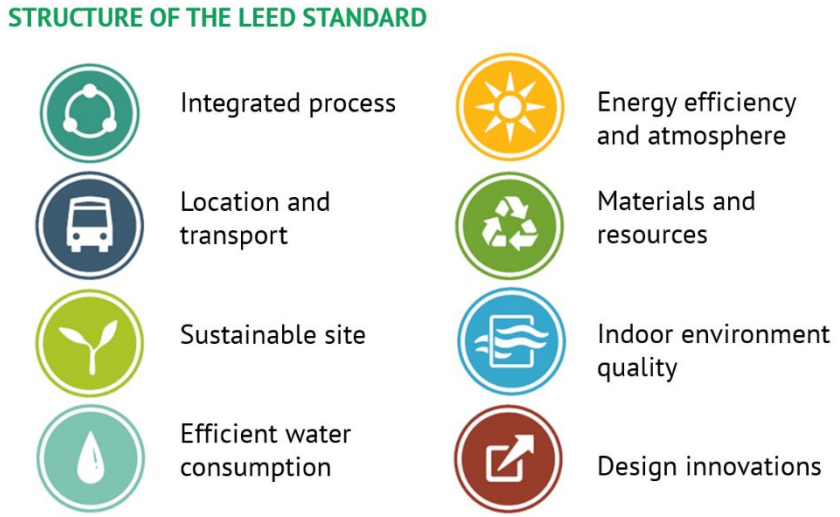
Guidelines are currently written for:

- Design of new construction and major renovations,
- Commercial interiors (i.e. office fit-ups),
- Management and operation of existing buildings (offices, multi-residential, retail, healthcare, light industrial),
- Building emergency management, and
- Building environment.

Each Green Globes confidential self-assessment questionnaire measures the environmental performance of buildings in seven relevant categories :

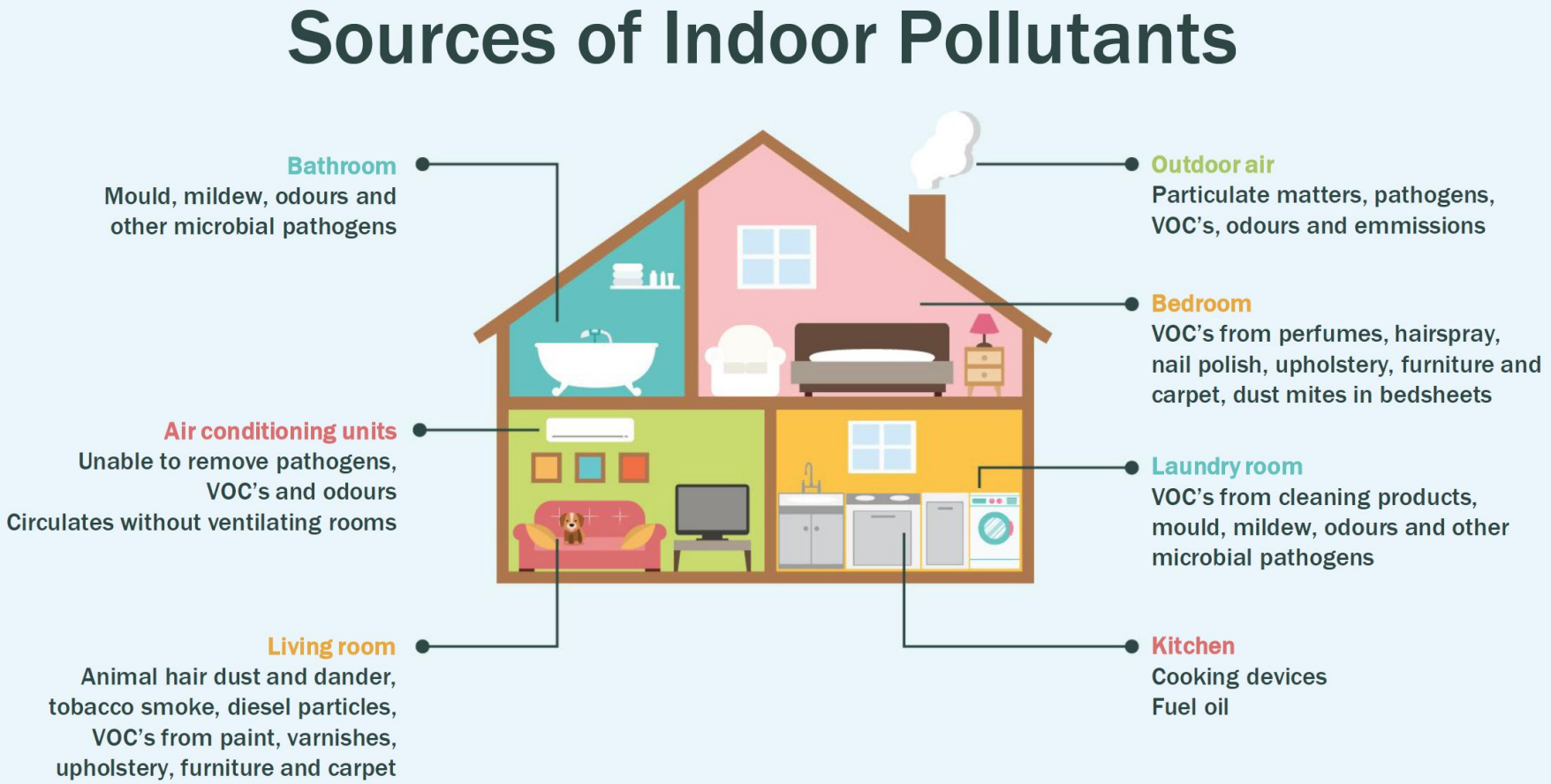
- Project Management,
- Site,
- Energy,
- Water,
- Resources,
- Emissions/Impacts, and
- Indoor Environment

Types of LEED Assessment standard



Integrated process – 1 point – a group of criteria dedicated to an integrated approach to design and construction
Location and transport 16 points – a group of criteria dedicated to urban planning and transport accessibility
Sustainable plots – 10 points – a group of criteria dedicated to the best practices of landscaping, ecology, and hydrology of the land plot
Water use efficiency – 11 points – a group of criteria dedicated to the rational use and saving of water
Energy efficiency and atmosphere – 33 points – a group of criteria dedicated to the reduction of greenhouse gas emissions, energy efficiency, the quality of building systems, and renewable energy
Materials and resources – 13 points – a group of criteria dedicated to the rational management of materials and waste, including separate collection, recycling, and life cycle analysis
The quality of the indoor environment is 16 points – a group of criteria dedicated to the health, comfort, and safety of people inside the building.
Innovations in design – 6 points – a group of criteria dedicated to new methods of design and construction
Regional priority – 4 – additional points that are awarded from the fulfillment of certain criteria, depending on the region of construction
Finally – 110 points.

Indoor air quality



What is indoor air pollution?
Indoor air pollution is created by the release of harmful pollutants inside. These can include fine particulate matter, carbon monoxide, and various other toxins.

Indoor air pollution is a big problem in developing countries, where people often burn fuels indoors for cooking and heating. It is also a concern for people living in energy-efficient homes. These properties tend to be relatively airtight, meaning that the air inside can quickly become stagnant and pollutant levels can rise rapidly.

Green Design Strategies include the following

- Site Selection & Planning – which includes site selection, soil erosion, and sedimentation control, use of alternative transportation, stormwater management, organic farming, urban heat island effect and light pollution reduction
- Water Efficiency – which includes a reduction in building water usage, reduction in landscape water usage, rainwater harvesting, water recycling, and reuse of treated water.
- Energy Efficiency – which includes building commissioning, optimization of energy performance, use of renewable energy such as PV panels and solar hot water collectors, elimination of CFC and HCFC, and measurement and verification after occupancy.
- Materials and Resources – which includes storage and recollection of wet and dry waste, building and material reuse, materials with recycled content, locally available materials, rapidly renewable materials, and certified wood
- Indoor Air Quality - which includes smoke control, outdoor air delivery monitoring, increased ventilation, air quality during construction and after construction, low VOC paints, adhesives, sealants, carpet, and composite wood, and adequate daylight and views.

Water and waste management systems

Sustainable Waste Management

- Growing in waste generation & disposal rates will increase pressures on the environment.
- Sustainable waste management aims to address these long term pressures through:
  - Recovery
  - Recycling
  - Reuse of resources
  - minimization of waste streams
  - management of resources in an environmentally sound and economically effective manner

Waste Management In LEED Buildings

- Storage and Collection of Recyclables
- Construction Waste Management
- Materials Reuse
- Waste Stream Audit
- Ongoing Consumables
- Durable Goods
- Facility Alterations and Additions

WATER MANAGEMENT

- Minimising water use is achieved by installing grey water and rainwater catchment systems that recycle water for irrigation or toilet flushing.
- Water-efficient appliances, such as low flow showerheads, self-closing or spray taps; low-flush toilets, or waterless composting toilets shall be used.
- Installing point of use hot water systems and lagging pipes saves on water heating.
- Management of water by two methods:-
  - Grey water recycling
  - Rain water harvesting

GREY WATER RECYCLING

- Grey water is wastewater generated from domestic activities such as laundry, bathing and dishwashing.
- It comprises of about two-thirds of domestic water use.
- It gets its name from the cloudy appearance and from its status as neither being fresh nor polluted.
- Grey water is easier to treat and recycle because of the low levels of contamination.
- If the grey water is harvested on a separate plumbing, the grey water can be recycled, stored and re-used.

PURPOSE OF GREY WATER RECYCLING

- Reduces fresh water requirement
- Reduce sewage generation
- Toilet flushing
- Floor cleaning
- Irrigation
- Gardening
- Car washing
- Construction

BENEFITS OF GREY WATER RECYCLING

- Lower fresh water extraction from rivers and lakes
- Reduce strain on septic tank or treatment plant
- Ground water recycling
- Irrigation and plant growth
- Maintain soil fertility
- Enhance water quality

Integrated ecological design, Sustainable site and landscaping