Capacity Building in Built Environment
Sustainability Research (CAPABLE)

WORKSHOP ON

Green Buildings & Sustainability

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1. INTRODUCTION

Trends in evolving green building through timeline:
Green building practices have evolved from basic energy conservation methods in the 1970s to integrated sustainability frameworks in the 21st century, focusing on energy efficiency, renewable energy adoption, and net-zero carbon targets.

Global Green Building Rating Systems:
LEED (USA), BREEAM (UK), IGBC (India), and Green Star (Australia) provide standardized frameworks for assessing sustainability in building design, construction, and operation.

Green Building Rating Systems in India:

- Indian Green Building Council (IGBC): Categories, criteria, process
- Leadership in Energy and Environmental Design (LEED): Global applicability and certification levels.
- Green Rating for Integrated Habitat Assessment (GRIHA): Government support and mandatory compliance in India.

Green Building Codes in India:

- ECBC (Energy Conservation Building Code): Compliance requirements and energy-saving potential.
- ENS (Energy-Neutral Systems): Design principles and case examples.
- ASHRAE Standards: Focus on HVAC systems and energy efficiency.
- NBC (National Building Code): Sustainability-related chapters and application.

2. SUSTAINABLE SITES

Site selection is crucial as it directly affects environmental impact, energy consumption, and building performance. A well-chosen site minimizes habitat disruption, conserves natural resources, and enhances occupant comfort through passive design strategies.

Brownfield Redevelopment:

- Reclaiming and developing previously used or contaminated land, reducing urban sprawl by making use of existing infrastructure, helping in environmental cleanup and revitalization of communities.

Reducing Heat Islands:

- Involving using reflective materials, green roofs, and tree planting, minimizing heat absorption, lowering cooling demands, improving urban microclimates and air quality.

Natural Topography & Vegetation:

- Preserving site ecology, protecting natural ecosystems by conserving native vegetation and wildlife habitats, preventing soil erosion, enhancing biodiversity and ensuring environmental resilience, incorporating natural features like wetlands and forests into site planning.

3. WATER MANAGEMENT

Strategic planning, development, distribution, and regulation of water resources to ensure their sustainable use, quality, and availability, involving managing water supply, controlling water pollution, and implementing conservation practices to balance human needs with environmental sustainability.

Rainwater Harvesting, Water Reuse, and Recycling

- Rainwater harvesting and using for irrigation, flushing.
- Treating wastewater, reducing demand on freshwater.

Water-Efficient Fixtures

- Water-efficient fixtures such as low-flow faucets, showerheads, and dual-flush toilets, to maintain performance, lower utility bills and environmental impact.

Water-Efficient Landscape

- Drought-tolerant plants, mulch, and drip irrigation to minimize water use, enhancing site aesthetics, conserving water and reducing maintenance needs.

Strategies for Zero-Discharge Sites

- Zero-discharge sites manage all wastewater on-site through methods like constructed wetlands and bio-retention systems, ensuring water is treated naturally, eliminating off-site discharge and pollution.

4. ECO-FRIENDLY MATERIALS

Sustainably sourced, energy-efficient, and non-toxic materials that minimize environmental impact while promoting resource conservation and reducing carbon emissions.

Criteria for Material Selection

- High recycled content materials reduce waste and conserve natural resources and help minimize the environmental impact associated with extracting raw materials.
- Low embodied energy materials reduce overall energy consumption during production, transportation, and installation.
- Locally available materials reduces transportation emissions and supports regional economies, enhancing sustainability and project efficiency.

Certifications

- EPD (Environmental Product Declaration): Transparent information about a product's environmental impact throughout its life cycle, supporting informed material selection.
- FSC (Forest Stewardship Council): Wood products come from responsibly managed forests, promoting sustainable forestry and biodiversity conservation.

Examples of Green Materials

- Bamboo, cork, Reclaimed wood, recycled metal, and recycled plastic, Low-VOC paints, adhesives, Natural stone, clay plaster, Fly ash concrete and geopolymer concrete.

5. PASSIVE DESIGN

Using building orientation, materials, and natural environmental factors like sunlight, wind, and thermal mass to regulate indoor temperatures and reduce reliance on mechanical heating and cooling systems.

Climate-responsive architecture

- Climate-responsive architecture processes involve designs considering local climate conditions to enhance comfort and energy efficiency.
- It integrates elements like orientation, shading, and material selection to adapt to seasonal temperature changes and weather patterns.

Strategies for passive heating, cooling, and daylighting

- Passive Heating: South-facing windows, thermal mass materials, and insulated walls capture and store solar heat in winter.
- Passive Cooling: Cross-ventilation, shading devices, and reflective roofs reduce indoor temperatures by promoting natural cooling.
- Daylighting: Skylights, light shelves, and strategically placed windows maximize natural light, reducing the need for artificial lighting.

6. ENERGY EFFICIENCY

Enhance energy efficiency of the buildings to reduce environmental impacts from excessive energy use.

Minimum Energy Performance:
Ensuring that buildings meet minimum energy efficiency standards throughout their operational life.

Efficient Lighting:
LED lighting consumes less energy, lasts longer, and reduces maintenance costs compared to traditional lighting, daylight sensors and lighting power density reduction strategies ensure optimal lighting levels while minimizing energy consumption.

Efficient HVAC System:
Optimizing HVAC system design includes proper sizing, zoning, and energy-efficient components to reduce heating and cooling loads.

7. RENEWABLE ENERGY

Renewable Energy comes from naturally replenished sources like solar, wind, hydro, geothermal, and biomass, offering a sustainable and environmentally friendly alternative to fossil fuels.

Solar Photovoltaics

- Fundamentals of photovoltaic technology, with how solar panels convert sunlight into electricity, system components such as solar modules, inverters, and battery storage, highlighting their roles in energy generation and storage.
- Site assessment, system design, and the economics of solar power, cost-benefit analysis and government incentives.

Wind

- Capturing wind power using turbines to generate renewable electricity on a utility or residential scale, including turbine types, their design basics and modern wind farm construction techniques.

8. INDOOR ENVIRONMENTAL QUALITY (IEQ)

Indoor Environmental Quality is the overall health, comfort, and well-being of building occupants, influenced by factors such as air quality, lighting, thermal comfort, and acoustics.

Parameters for Health and Well-being:

- Essential parameters like adequate ventilation, ensuring fresh air circulation and reducing indoor contaminants, and maximizing daylight access to improve occupant productivity.

Strategies to maintain Low Indoor Pollutants:

- Selecting non-toxic, low-VOC materials for construction, finishes, and furnishings. Learn how sustainable material choices reduce exposure to harmful chemicals, contributing to healthier indoor environments.

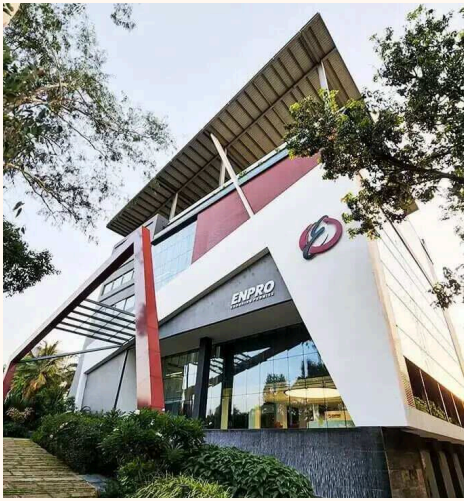
Case Examples:

- Showcase of real-world projects that prioritize IEQ through design, materials, and systems integration. Successful examples demonstrate how thoughtful planning and execution enhance air quality, thermal comfort, and overall occupant well-being.

9. SITE VISITS

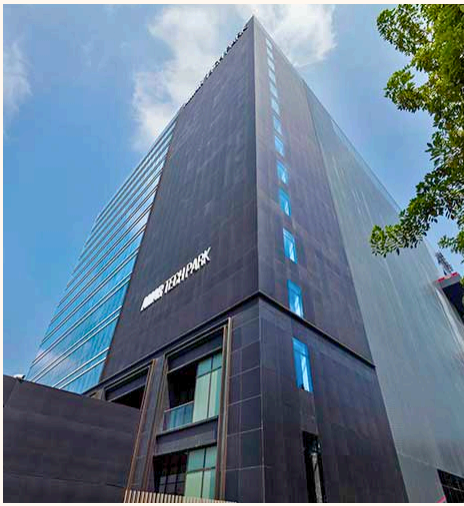
Enpro Industries (01)

LEED Platinum rated building demonstrates a commitment to sustainability through advanced energy management, water conservation, and environmentally responsible construction practices, integrating renewable energy systems, efficient HVAC, and eco-friendly materials, setting a benchmark for green building performance.



Amar Tech Park (02)

IGBC Platinum rated building exemplifies sustainability through energy-efficient design, water conservation, and eco-friendly construction practices. Its features include advanced HVAC systems, renewable energy integration, and green landscaping, promoting environmental responsibility and occupant well-being.



10. RESOURCES

1. References: Relevant Books, Standards, and Research Papers

- Books:
  - "Sustainable Construction: Green Building Design and Delivery" by Charles J. Kibert
  - "The Green Building Handbook" by Tom Woolley et al.
  - "Design with Climate" by Victor Olgyay
- Standards:
  - IGBC Rating System Manual (https://igbc.in/)
  - ECBC (Energy Conservation Building Code) (https://beeindia.gov.in/en/energy-conservation-building-code-ecbc)
  - LEED Rating System Guidelines (https://www.usgbc.org/leed)

2. Templates: Checklists and Forms for Rating Systems

- LEED Certification Checklists: Site selection, water efficiency, energy use, material selection, and indoor environmental quality forms.
- IGBC Certification Templates: Energy efficiency, sustainable site management, and innovation forms.

3. Tools: Software Resources for Energy Modeling and Simulations

- Energy Modeling Software and Simulation Tools:
  - EnergyPlus – For comprehensive building energy simulations.
  - DesignBuilder – User-friendly interface for energy modeling.
  - eQUEST – Energy simulation for HVAC, building performance analysis.
  - Revit – For designing and analyzing green buildings.
  - SketchUp with Sefaira – For real-time energy performance analysis.

NOTES

NOTES

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