



Department of Civil Engineering

Name of Subject: - **ENERGY CONSERVATION & GREEN BUILDING (ECG)**

Course Code: - **315316**

Scheme:- **CE-5K**

Semester:- **Fifth**

Unit No. 02

Green Building Concepts and Sustainable Practices

CO2 - Implement the green principles in the green building construction

Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
II	Green Building Concepts and Sustainable Practices	CO2	8	4	4	6	14

THEORY SYLLABUS CONTENT

Unit - II Green Building Concepts and Sustainable Practices

2.1 Green Building Principles: a. Sustainable Site Design

b. Energy Efficiency and conservation c. Water Efficiency and conservation d. Materials selection and life cycle analysis e. Indoor environmental quality (IEQ)

2.2 Salient features of Green Building

2.3 Benefits of Green building: Environmental, economic and social benefits.

2.4 Future trends in green building

2.5 Economical Consideration of green buildings: Initial cost, long term Financial Benefits and Economic Impacts on Stakeholders.

Subject Incharge

Mr. D. B. Wagh

Unit-02

Green Building concepts and sustainable Practices

* Green Building Principles :-

- 1) Sustainable site design
- 2) Energy efficiency and conservation.
- 3) Water Efficiency and conservation.
- 4) Materials selection and life cycle analysis
- 5) Indoor environmental quality (IEQ)

1) Sustainable site design :-

- a) Site Assessment:- i) Before construction, a detailed study of land is done including topography, soil type, vegetation, water sources, and climate.
- ii) This helps in proper planning without disturbing the natural ecosystem.

- b) preservation of Natural features: Natural features like trees, hills, water bodies are preserved instead of levelling the whole site.

- c) Building orientation:- Buildings are placed according to sunlight and wind direction for maximum daylighting and natural ventilation.

- d) connectivity and Transportation:- Sites are planned with access to public transport, cycle tracks, and pedestrian walkways.

- e) Low-Impact construction practices:- sustainable site design balances development with nature, conserves natural resources, and promotes healthy, resilient, and eco-friendly communities.

2) Energy Efficiency and conservation:

- i) one of the main objectives of green buildings is to reduce energy consumption.
 - ii) Traditional buildings depend heavily on electricity for lighting, heating, cooling and appliances which increases carbon emissions and resources depletion.
 - iii) Green buildings adopt smart design, efficient appliances, renewable systems, and automation to save energy while maintaining comfort.
- ⇒ A) Use of energy-efficient appliances and fixtures.
- ⇒ B) smart Building Design for natural lighting and ventilation.

c] Effective Thermal Insulation

d] Use of smart controls and sensors.

→ Energy efficiency and conservation in green buildings is achieved through a combination of efficient appliances, passive design, renewable systems, insulation, and smart technology. This reduces carbon emissions, energy bills, and environmental impact while improving comfort and sustainability.

5) Water Efficiency and conservation.

- i) Green buildings are designed to use water efficiently and avoid waste, reducing stress on municipal supply
- ii) Water efficiency in green buildings is achieved by using low-flow fixtures, dual-flush toilets, rainwater harvesting, greywater, recycling and xeriscaping.
- iii) These measures ensure responsible water use, conservation of resources, and sustainable living.

4) Materials selection and life cycle analysis :-

- i) In green buildings, material selection is based not only on strength, durability, and cost but also on sustainability and environmental impact.
- ii) The aim is to use materials that are eco-friendly, safe, durable, and resource efficient, reducing the building's overall carbon footprint.
- iii) Material selection in green buildings focuses on recycling, local sourcing, durability, safety, renewable resources, and life cycle analysis.

5) Environmental quality (EQ) :-

- i) IEQ in green buildings is ensured through fresh Ventilation, low-toxin materials, natural daylight, acoustic control, and thermal comfort.
- ii) It enhances health, productivity, and overall indoor living quality.
- iii) Provide Good ventilation for fresh Air and also use of low-emission and non-toxic materials

Salient features of Green Buildings :-

1) Eco-friendly Design :-

- a) Green buildings begins with sustainable and smart architectural design.
- b) Proper orientation allows maximum use of natural light and airflow, reducing the need for artificial lighting and air conditioning.

2) Energy-efficient systems :-

- a) Green buildings use renewable energy sources like solar panels to generate electricity.
- b) LED lighting and smart control systems and sensors for consumes much less power.

3) Water-Saving Systems :-

- a) Green buildings use water-efficient plumbing systems such as low-flow faucets, showerheads, and dual-flush toilets.
- b) Rainwater harvesting collects and stores for gardening, flushing or cleaning.

4) Use of sustainable materials :-

- a) Green building prefers recycled and renewable materials like reclaimed wood, recycled steel, reused bricks, bamboo & cork.
- b) Use of eco-friendly cement alternatives such as fly ash-based concrete reduce greenhouse gas emissions.

5) Construction Waste Management :-

- a) Green building projects have a proper Waste Management plan.
- b) Construction and Demolition waste like concrete, metal, and wood is re-used or recycled. Hazardous material are disposed carefully and reduce landfill burden & pollution.

6) Healthy Indoor Air quality :-

- a) A major goal of green building is to create a healthy indoor environment.
- b) Use of non-toxic paints, adhesive, and finishes prevents harmful emission and ventilation brings in fresh air.

7) Green Roofs and Vertical Gardens:-

- a) Green roofs covered with plants provide natural insulation, reduce roof temperature, and absorb rainwater.
- b) Vertical gardens (green walls) improve air quality, reduce heat, and add beauty to the building.

8) Green Building Certifications:-

- a) To measure sustainability, green buildings are certified by rating systems.
- b) LEED, IGBC, GRIHA, these certification ensure that the buildings meets recognized environmental and performance benchmarks, increasing value and credibility.

Benefits of Green Buildings:-

A] Environmental Benefits

- B] Economic Benefits
- C] Social Benefits

A] Environmental Benefits:-

- 1) Less pollution
- 2) Waste Reduction
- 3) Resource conservation
- 4) Promotion of Biodiversity

B] Economic Benefits:-

- 1) Lower Electricity and water bills
- 2) Increase property value
- 3) Lower maintenance and operating cost
- 4) Government incentives and subsidies.

C] Social Benefits:-

- 1) Better health and comfort
- 2) Improved productivity
- 3) Increased Awareness and social Responsibility
- 4) Job creation in the Green Economy

* Future Trends in Green Building :-

* Present → Net Zero Buildings
→ Use of solar and wind power.

* Near Future → smart Buildings
→ Use of AI, IoT for Automation.

* Emerging Future → 3D Printing construction
→ Faster, Less waste, Eco materials

* Advanced future → climate Resilient structure
→ Withstand Natural disaster.

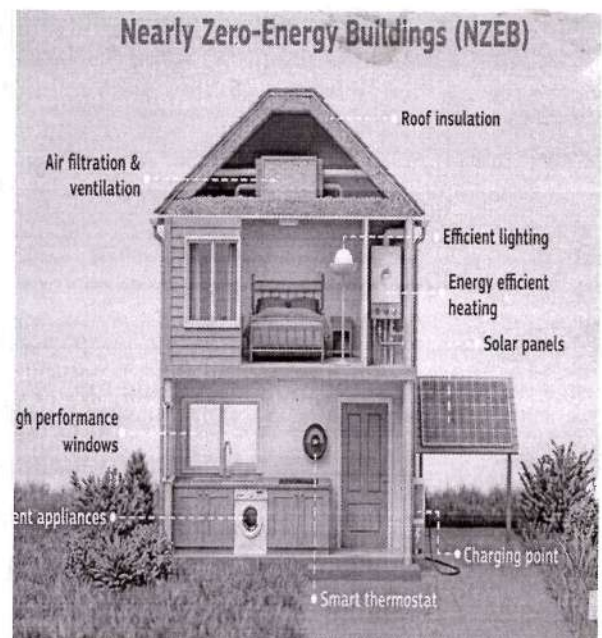


1. Net-zero Energy Buildings (NZBs)
2. smart Buildings with AI and IoT
3. Advanced and sustainable construction materials.
4. 3D Printed Buildings
5. Green Architecture and Biophilic Design.
6. Disaster-~~R~~ Resilient and climate-adaptive Buildings

1) Net-zero Energy Buildings (NZBs) :-

a) Net-zero energy buildings are designed to produce as much energy as they consume annually, achieving a balance between energy import and export. These buildings typically rely on renewable energy sources such as solar, wind turbines, or geothermal systems.

b) High-performance insulation, energy-efficient windows, and advanced HVAC systems reduce



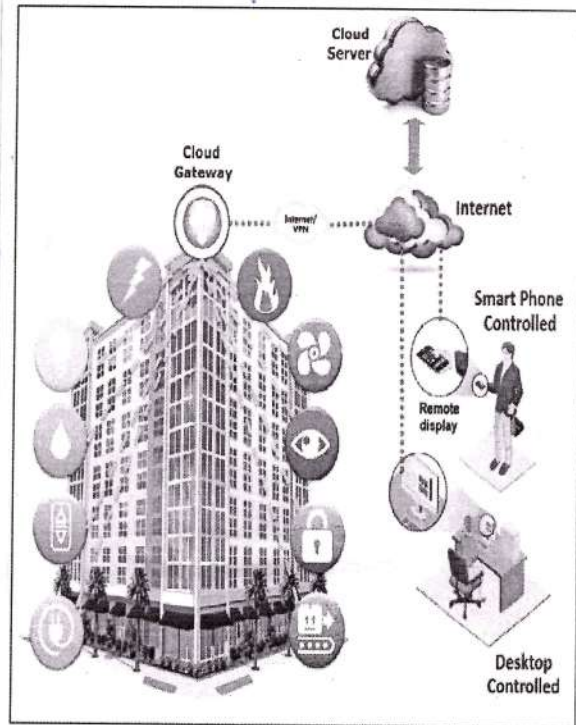
energy demand, while smart grid integration allows for energy storage and efficient distribution.

2) Smart Buildings with AI and IOT :-

a) Smart buildings use Internet of Things (IoT) devices and artificial intelligence to monitor and automate buildings functions such as lighting, heating, ventilation, air conditioning (HVAC), water usage, and security.

b) For example, occupancy sensors can turn off lights and adjust temperature when rooms are not in use improving energy efficiency.

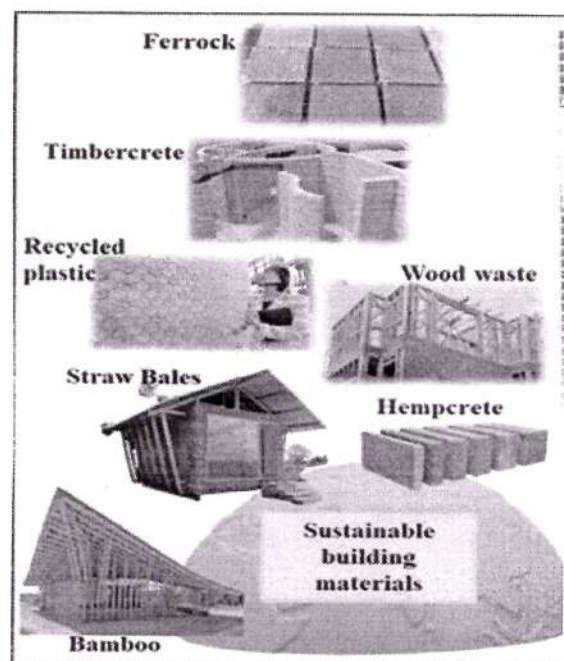
AI can also predict maintenance needs, optimize energy loads, and enhance user comfort.



3) Advanced and Sustainable construction Materials:-

a) Emerging construction materials are driving the green buildings revolution. Carbon-neutral concrete, made by capturing and storing CO₂ during production, significantly reduces the carbon footprint of traditional construction.

b) Recycled materials such as plastic, glass, and rubber are being reengineered into durable construction components. Additionally, bioplastics, bamboo, hemcrete, and mycelium based composites are gaining popularity.

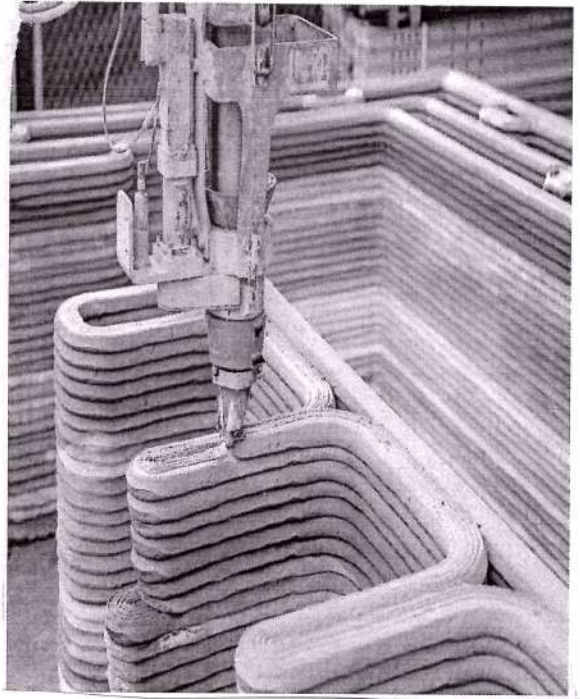


due to their biodegradability and low embodied energy. These innovations help conserve resources, reduce landfill waste, and minimize environmental impact.

4) 3D Printed Buildings :-

a) 3D Printing in construction, also known as additive manufacturing, enables rapid and precise fabrication of building components or entire structures using layer-by-layer printing techniques. These buildings are constructed faster with less labour and material waste compared to conventional methods.

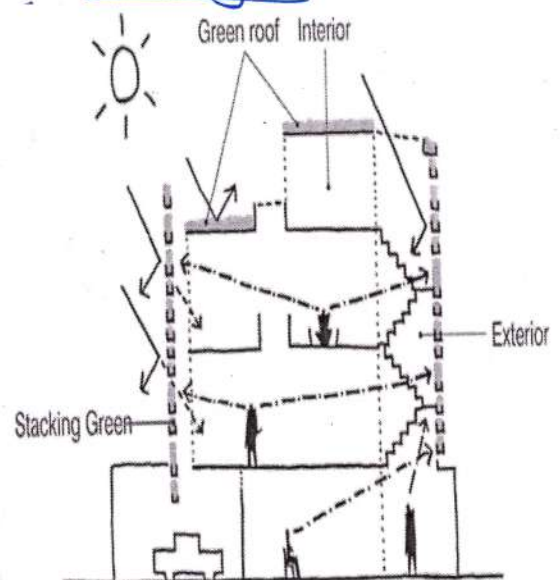
b) Materials used often include cement-based mixtures or sustainable alternatives like geopolymers concrete.



5) Green Architecture and Biophilic Design :-

a) Green architecture integrates living elements like green roofs, vertical gardens, and natural landscaping into building designs. These features not only enhance the aesthetic and ecological value of a building but also regulate indoor temperature, improve air quality, and reduce storm water runoff.

b) It contributes to occupant well-being, productivity, and mental health, making them ideal for residential, commercial, and institutional buildings.

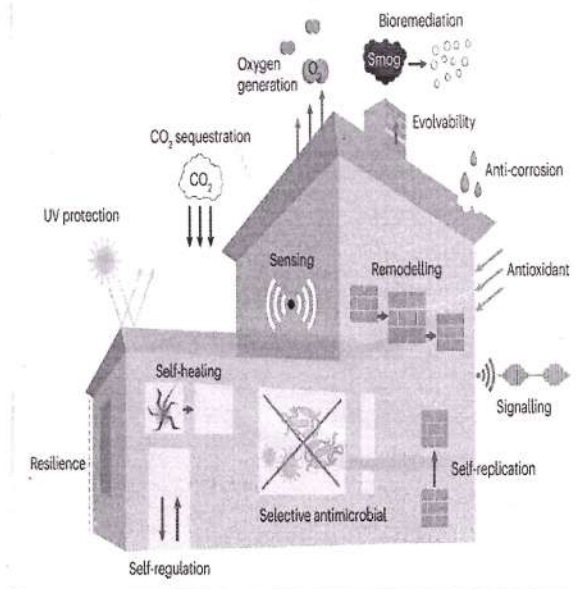


The people can feel the greenery illuminated by sunlight from everywhere of this house

Section Diagram

6) Disaster-Resilient and climate-adaptive Buildings :-

a) With climate changes increasing the frequency and intensity of natural disaster, there is a growing focus on designing buildings that can resist floods, earthquakes, wildfires, and high winds. Resilient buildings incorporate elevated structures, flood-proof materials, seismic isolation systems, and wind-resistant forms.



* Economical consideration of green buildings :-

- 1) Initial cost
- 2) long term financial Benefits and
- 3) Economic Impacts on stakeholders.

1) Initial cost of green buildings :-

- a) Green building have high initial cost than normal buildings because they use advanced materials and technologies.
- b) Materials like low-VOC paints, recycled products, energy-efficient insulation, and eco-Friendly concrete are more expensive
- c) Adding solar panels, smart sensors, rainwater harvesting, and greywater systems increases the budget, but these are long-term investments.

2) Long-term financial Benefits :-

- a) Even though initial cost is high, green buildings save money in the long run.
- b) The reduce electricity and water bills by using

- efficient appliances, LED lights, and water-saving fixtures.
- c) maintenance costs are lower because of durable materials and smart systems that reduce frequent repairs
 - d) Governments also gives subsidies, tax benefits, and fast approvals for green projects.
 - e) Properties with green certifications (IGBC, LEED, GRIHA) have higher resale value, making them profitable investment.

3) Impact on stakeholders :-

- a) Owners & Residents
 - i) Enjoy lower utility bills, fresh air, better natural lighting, and thermal comfort.
 - ii) Health Improves due to good indoor air quality, leading to fewer sick days and higher productivity

b) Builders and Developers :-

- i) Gain a competitive edge by constructing eco-friendly projects
- ii) Can attract more customers and charge premium prices as demands for sustainable spaces grows.

c) Government and Society :-

- i) Society benefits from reduced pollution, lower greenhouse gas emissions, better stormwater control, and cooler urban temperatures.
- ii) The reduces the burden on public health systems and environmental cleanup costs

d) Workers and Professionals :-

- i) Creates new jobs in solar installation, green material manufacturing, energy auditing, and environment consulting.
- ii) Encourages professionals to upgrade skills in modern sustainable technologies.

Unit No. 02

Green Building Concepts and Sustainable Practices

Important Questions:-

- 1) Enlist salient features of green building ?
- 2) Why Indoor Environmental Quality is Important in green buildings ?
- 3) Write suitable building materials name
- 4) What are the economic benefits of green buildings ?
- 5) Enlist the various principles of Green building.
- 6) Describe any four points of Environmental benefits of green building.
- 7) Describe the concept of net-zero energy buildings (NZEBs). How are they different from regular buildings ?
- 8) Enlist salient features of green building. Explain one in details
- 9) What do you mean by green building and long term financial benefits of green building.
- 10) Define a green building. What are the key objectives behind its design and construction.
- 11) Explain Sustainable site design
- 12) Describe future trends in green building.
- 13) What are smart buildings and how do AI and IoT contribute to their functioning ? Give two practical Example
- 14) What are economical benefits of green buildings
- 15) Explain water efficiency and conservation.