

CE3010 SUSTAINABLE CONSTRUCTION AND LEAN CONSTRUCTION

QUESTION BANK

PART A

UNIT I - INTRODUCTION & MATERIALS USED IN SUSTAINABLE CONSTRUCTION

1. Define sustainability in the context of construction.

- Sustainability in construction refers to designing, constructing, and maintaining structures with minimal environmental impact, efficient resource use, and long-term durability.

2. What is the carbon cycle, and why is it important for sustainability?

- The carbon cycle is the natural process of carbon exchange between the atmosphere, oceans, and living organisms. It is crucial for sustainability as it regulates CO₂ levels, impacting climate change.

3. How does concrete contribute to CO₂ emissions?

- Concrete production releases CO₂ mainly through cement manufacturing, which involves the decomposition of limestone (CaCO₃) and energy-intensive processes.

4. What are recycled aggregates, and why are they important?

- Recycled aggregates are crushed concrete, asphalt, or other materials reused in construction, reducing landfill waste and conserving natural resources.

5. Differentiate between recycled and manufactured aggregates.

- Recycled aggregates come from demolished structures, while manufactured aggregates are artificially produced from industrial by-products like slag.

6. How does durability impact the sustainability of construction materials?

- Durable materials extend the life cycle of structures, reducing maintenance costs and resource consumption, leading to sustainability.

7. Explain the life cycle of a construction material.

- It includes raw material extraction, production, transportation, usage, maintenance, and end-of-life disposal or recycling.

8. What is the role of sustainability assessment in construction?

- It evaluates a building's environmental, economic, and social impact over its lifecycle to promote sustainable practices.

9. Define embodied carbon in construction materials.

- Embodied carbon refers to the total CO₂ emissions generated during the production, transportation, and installation of a material.

10. Explain the impact of cement on environmental sustainability.

- Cement production leads to high CO₂ emissions, depletes natural resources, and consumes large amounts of energy and water.

UNIT II - ENERGY CALCULATIONS

1. What is embodied energy in construction?

- Embodied energy is the total energy required to extract, process, and manufacture, transport, and install construction materials.

2. What are the main components of embodied energy?

- (i) Raw material extraction energy
- (ii) Manufacturing energy
- (iii) Transportation energy
- (iv) Construction and installation energy
- (v) Demolition and disposal energy

3. How is embodied energy calculated for construction materials?

- It is calculated by summing the energy used in raw material extraction, processing, manufacturing, transportation, and construction, usually expressed in **MJ/kg** or **MJ/m²**.

4. How does embodied energy differ from operational energy?

- **Embodied energy** is the energy used in material production and construction, while **operational energy** is the energy consumed during a building's use (heating, cooling, lighting, etc.).

5. What factors influence the embodied energy of a material?

- (i) Extraction and processing methods
- (ii) Transportation distance
- (iii) Manufacturing techniques
- (iv) Recycling potential

6. Why is embodied energy important in sustainable construction?

- It affects a building's total energy footprint and helps reduce CO₂ emissions, leading to a more sustainable construction industry.

7. How does embodied energy compare to operational energy in a conditioned building?

- In a highly energy-efficient building, embodied energy can be **as high as operational energy** over the building's lifespan, making material selection crucial.

8. What is Life Cycle Energy Use in buildings?

- It is the total energy used throughout a building's life, including embodied, operational, maintenance, and demolition energy.

9. How can embodied energy be reduced in construction?

- (i) Using recycled and locally available materials
- (ii) Choosing energy-efficient manufacturing processes
- (iii) Adopting prefabrication and modular construction

10. How does Life Cycle Assessment (LCA) help in energy-efficient construction?

- LCA evaluates a material's environmental impact, helping designers choose sustainable options with lower embodied energy.

UNIT III - GREEN BUILDINGS

1. How does the National Building Code (NBC) help in energy control in buildings?

- NBC provides guidelines on energy efficiency, sustainable construction, and building materials to reduce energy consumption in buildings.

2. What is the Energy Conservation Building Code (ECBC)?

- ECBC is a code developed by the Bureau of Energy Efficiency (BEE) in India that sets energy efficiency standards for commercial buildings to reduce energy consumption.

3. What is Overall Thermal Transfer Value (OTTV), and why is it important?

- OTTV measures the heat gain of a building through walls and roofs, helping designers improve energy efficiency by optimizing insulation and materials.

4. What are the key features of the LEED rating system?

- LEED (Leadership in Energy and Environmental Design) evaluates buildings based on sustainability, water efficiency, energy use, materials, and indoor environmental quality.

5. What is TERI-GRIHA, and how does it promote green buildings?

- TERI-GRIHA (Green Rating for Integrated Habitat Assessment) is an Indian green building rating system that encourages energy efficiency, water conservation, and sustainable materials.

6. How does insulation improve building energy efficiency?

- Insulation reduces heat transfer, maintaining indoor temperatures and lowering heating and cooling energy consumption.

7. How does moisture content affect the thermal properties of construction materials?

- Higher moisture content reduces insulation effectiveness, increasing heat transfer and energy consumption in buildings.

8. What is the concept of a Zero Energy Building (ZEB)?

- A Zero Energy Building produces as much energy as it consumes annually through renewable sources like solar panels, making it energy neutral.

9. How do performance ratings classify green buildings?

- Green buildings are rated based on energy efficiency, water conservation, indoor air quality, material sustainability, and overall environmental impact (e.g., LEED, GRIHA).

10. How do tropical countries regulate energy-efficient building construction?

- Tropical countries implement building codes with passive cooling techniques, natural ventilation, reflective roofing, and efficient insulation to minimize energy use.

UNIT IV - CORE CONCEPTS IN LEAN

1. What is the primary objective of this course?

- The course aims to introduce Lean principles, the need for productivity measurement, and methods to improve productivity in various industries.

2. What is Lean, and why is it important?

- Lean is a methodology that focuses on eliminating waste, improving efficiency, and maximizing value in processes. It is important for reducing costs and increasing productivity.

3. Why is productivity measurement necessary?

- Productivity measurement helps assess efficiency, identify areas for improvement, and optimize resource utilization in organizations.

4. What are the key benefits of improving productivity?

- (i) Increased profitability
- (ii) Better resource utilization
- (iii) Improved quality and customer satisfaction

5. What is a Productivity Measurement System (PMS)?

- PMS is a framework used to quantify productivity by measuring inputs and outputs, helping organizations track performance and improvements.

6. Mention two common productivity measurement metrics.

- (i) **Labor productivity** = Output per worker
- (ii) **Total Factor Productivity (TFP)** = Output per unit of all inputs (labor, materials, energy)

7. How does Lean improve productivity?

- Lean eliminates non-value-adding activities (waste), streamlines workflows, and enhances process efficiency.

8. What are the main types of waste in Lean methodology?

- (i) Overproduction
- (ii) Waiting time
- (iii) Defects
- (iv) Excess inventory
- (v) Unnecessary motion
- (vi) Over processing
- (vii) Unused talent

9. How does a PMS help in decision-making?

- A PMS provides data-driven insights, enabling organizations to identify inefficiencies, set performance benchmarks, and make informed strategic decisions.

10. What are the key components of a Productivity Measurement System (PMS)?

- (i) Data collection and analysis
- (ii) Performance indicators
- (iii) Benchmarking and goal setting
- (iv) Continuous improvement strategies

UNIT V - LEAN CONSTRUCTION TOOLS AND TECHNIQUES

1. What is work sampling, and why is it used?

- Work sampling is a statistical technique used to estimate the proportion of time spent on different activities by randomly observing workers at intervals. It helps in identifying productivity improvements.

2. What is a foreman delay survey?

- A foreman delay survey is a study conducted to identify the causes of delays in construction projects by tracking time lost due to material shortages, equipment issues, or coordination problems.

3. What is Value Stream Mapping (VSM), and why is it important?

- VSM is a Lean tool that visualizes the entire process flow, identifying inefficiencies and waste to optimize operations and improve productivity.

4. What is the 5S methodology, and how does it improve productivity?

- The 5S methodology (Sort, Set in Order, Shine, Standardize, Sustain) organizes the workplace for efficiency, reducing waste, improving safety, and enhancing productivity.

5. What is the Collaborative Planning System (CPS) in construction?

- CPS is a planning approach where multiple stakeholders collaborate to optimize workflows, reduce delays, and enhance efficiency in construction projects.

6. What is the Last Planner™ System (LPS), and how does it benefit construction projects?

- LPS is a Lean construction planning system that improves workflow reliability by focusing on short-term planning, commitment-based scheduling, and continuous improvement.

7. What is the Big Room Approach in Lean construction?

- The Big Room Approach brings all project stakeholders together in a shared space for real-time collaboration, decision-making, and problem-solving to improve efficiency.

8. How does IT/BIM contribute to Lean construction?

- IT and Building Information Modeling (BIM) improve collaboration, reduce rework, enhance visualization, and optimize resource allocation, supporting Lean principles.

9. What are some Lean tools that can be implemented on a project site?

- Common Lean tools include 5S, Value Stream Mapping, Last Planner™ System (LPS), Just-in-Time (JIT), and Pull Planning.

10. How can a construction project start practicing Lean tools?

- A project can start practicing Lean by training teams, adopting Lean tools like 5S and VSM, improving planning with LPS, using BIM for coordination, and fostering a culture of continuous improvement.

PART – B

UNIT I - INTRODUCTION & MATERIALS USED IN SUSTAINABLE CONSTRUCTION

1. Explain the concept of sustainability and its significance in the construction industry. How does the carbon cycle relate to sustainable construction practices?
2. Describe the role of construction materials like concrete and steel in modern infrastructure. How do these materials impact the environment?
3. Discuss the contribution of cement and other construction materials to CO₂ emissions. What are the potential ways to reduce their carbon footprint?
4. Illustrate the importance of recycled and manufactured aggregates in sustainable construction. How do they compare to traditional aggregates in terms of performance and environmental impact?
5. Summarize the role of quality control (QC) and durability in ensuring the sustainability of construction materials. How do these factors influence the life cycle of a structure?

UNIT II - ENERGY CALCULATIONS

1. Explain the concept of embodied energy in construction materials. What are the key components that contribute to embodied energy?
2. Describe the process of calculating the embodied energy of construction materials. Why is it important to consider embodied energy in sustainable construction?
3. Discuss the concept of energy in construction, distinguishing between primary energy and embodied energy. How do these energy forms influence material selection?
4. Explain the relationship between embodied energy and operational energy in a conditioned building. How do they impact the overall energy efficiency of a structure?
5. Review the significance of life cycle energy use in buildings. How does understanding life cycle energy help in making sustainable construction decisions?

UNIT III - GREEN BUILDINGS

1. Explain the importance of energy control in buildings. How do building codes like the National Building Code (NBC) and Energy Conservation Building Code (ECBC) help regulate energy efficiency?
2. Describe the Overall Thermal Transfer Value (OTTV) concept and its significance in energy-efficient building design. How is OTTV calculated?
3. Discuss the key features of LEED, TERI, and GRIHA ratings in assessing green building performance. How do these rating systems promote sustainability?
4. Elucidate the role of insulation and the thermal properties of construction materials in improving building energy efficiency. How does moisture content influence these properties?

5. Summarize the concept of a Zero Energy Building (ZEB). How do performance ratings of green buildings contribute to achieving zero energy status?

UNIT IV - CORE CONCEPTS IN LEAN

1. Explain the concept of Lean and its importance in the construction and manufacturing industries. How does Lean contribute to efficiency and waste reduction?

2. Describe the need for productivity measurement and improvement in industries. How does measuring productivity impact overall operational performance?

3. Discuss the different methods used in a Productivity Measurement System (PMS). How can these methods help organizations track and enhance productivity?

4. Explain the relationship between Lean principles and productivity improvement. How can Lean methodologies be applied to optimize workflow and resource utilization?

5. Condense the key components of a Productivity Measurement System (PMS) and its role in achieving continuous improvement in industries.

UNIT V - LEAN CONSTRUCTION TOOLS AND TECHNIQUES

1. Explain the concept of work sampling and foreman delay survey in productivity analysis. How do these techniques help in identifying inefficiencies in construction projects?

2. Describe the importance of Value Stream Mapping (VSM) and Process Mapping in Lean construction. How do these tools help in identifying and eliminating waste?

3. Discuss the 5S methodology in Lean construction. How does it contribute to improved workplace organization and efficiency on project sites?

4. Explain the role of Collaborative Planning Systems (CPS), Last Planner™ System (LPS), and the Big Room Approach in enhancing teamwork and project coordination. How do these methods improve project outcomes?

5. Review the impact of IT, Building Information Modeling (BIM), and Lean tools on construction project efficiency. How can a project team start implementing Lean tools effectively on a construction site?