What are Sustainable Materials?

Worksheet

Sustainable materials are construction materials with low embodied carbon, renewable or recycled content, and long service life - such as timber, bamboo, rammed earth, and recycled steel - chosen to reduce a building's total environmental footprint.

Questions

1. Embodied carbon includes emissions from

A) Only the building's operational energy use
B) Extraction, manufacturing, and transport of materials
C) Only the architect's travel
D) Only demolition

2. Which material typically has the LOWEST embodied carbon per kg?

A) Virgin steel
B) Concrete
C) Rammed earth
D) Aluminum

3. 5,000 kg of a material with factor 0.10 kgCO2e/kg has embodied carbon of

A) 50 kgCO2e
B) 500 kgCO2e
C) 5,000 kgCO2e
D) 50,000 kgCO2e

4. Choosing recycled steel over virgin steel primarily reduces

A) Building height
B) Embodied carbon
C) Window-to-wall ratio
D) Occupancy load

5. A project uses 5,000 kg of concrete with an emission factor of 0.13 kgCO2e/kg. Find the embodied carbon.

6. The same project could switch to cross-laminated timber (CLT) at 0.06 kgCO2e/kg for an equivalent 3,000 kg. Compare embodied carbon.

7. Recycled steel (0.45 kgCO2e/kg) replaces virgin steel (1.85 kgCO2e/kg) for a 2,000 kg structural frame. What is the carbon saved?

8. Define: What makes a material 'sustainable' in architecture?

9. Define: What is embodied carbon?

10. Define: Name three commonly used sustainable materials.

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Answer Key

1. B) Extraction, manufacturing, and transport of materials - Embodied carbon covers the full material life cycle - extraction, manufacturing, transport, and installation.

2. C) Rammed earth - Rammed earth uses minimally processed local soil, giving it very low embodied carbon compared to steel or aluminum.

3. B) 500 kgCO2e - EC = m f = 5000 0.10 = 500 kgCO2e.

4. B) Embodied carbon - Recycled steel avoids energy-intensive virgin ore processing, cutting embodied carbon significantly.

5. EC = m f EC = 5000 0.13 EC = 650 kgCO2e

6. EC(CLT) = 3000 0.06 = 180 kgCO2e EC(concrete) = 650 kgCO2e (from Example 1) Savings = 650 180 = 470 kgCO2e (72% reduction)

7. EC(virgin) = 2000 1.85 = 3700 kgCO2e EC(recycled) = 2000 0.45 = 900 kgCO2e Savings = 3700 900 = 2800 kgCO2e (76% reduction)

8. Low embodied carbon, renewable or recycled content, durability, and recyclability across its life cycle.

9. The total greenhouse gas emissions from extracting, manufacturing, transporting, and installing a material.

10. Timber/CLT, bamboo, and rammed earth (also recycled steel and reclaimed brick).

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