

What are Load-Bearing Systems?

Worksheet

A load-bearing system is the arrangement of structural elements - walls, columns, and beams - that transfers a building's weight and applied loads down to the ground; common types are load-bearing wall systems and skeletal frame systems.

$$\sigma = \frac{F}{A}$$

Questions

- Which system relies on columns and beams rather than walls to carry structural loads?
 - Load-bearing wall system
 - Skeletal frame system
 - Foundation system
 - Roofing system
- What is the formula for allowable axial load on a structural member?
 - $P = m g$
 - $P = A$
 - $P = F d$
 - $P = V I$
- Why is it hard to add large windows in a load-bearing wall system?
 - Windows are too expensive
 - The walls themselves carry the structural loads, so openings weaken them
 - Glass isn't allowed by code
 - Load-bearing walls are always underground
- A column has $\sigma = 10 \text{ MPa}$ and $A = 100,000 \text{ mm}^2$. What's its allowable axial load?
 - 10 kN
 - 100 kN
 - 1,000 kN
 - 10,000 kN
- A 3-story masonry building has load-bearing walls made of brick with an allowable stress of 8 MPa. A wall section has a cross-sectional area of 200,000 mm². What axial load can it carry?
- An architect wants large glass walls and an open floor plan for an office tower. Which load-bearing system fits better, and why?
- A reinforced concrete column has an allowable stress of 12 MPa and a cross-section of 90,000 mm² (300 mm x 300 mm). Find its allowable axial load.
- Define: What is a load-bearing system?
- Define: What are the two main types of load-bearing systems?
- Define: In a skeletal frame system, what carries the load?

Answer Key

1. B) Skeletal frame system - In a skeletal frame system, columns and beams carry the loads while walls can be non-structural.
2. B) $P = A$ - Allowable axial load equals allowable stress times cross-sectional area ($P = A$).
3. B) The walls themselves carry the structural loads, so openings weaken them - Since the walls carry the loads, large openings reduce their structural capacity.
4. C) 1,000 kN - $P = A = 10 \text{ N/mm} \times 100,000 \text{ mm} = 1,000,000 \text{ N} = 1,000 \text{ kN}$.
5. $P = A$ $P = 8 \text{ N/mm} \times 200,000 \text{ mm} = 1,600,000 \text{ N} = 1,600 \text{ kN}$
6. A load-bearing wall system would require thick, closely spaced walls, blocking views. A skeletal frame system moves the structure into columns and beams. This frees the walls to be lightweight glass curtain walls - the right choice here.
7. $P = A$ $P = 12 \text{ N/mm} \times 90,000 \text{ mm} = 1,080,000 \text{ N} = 1,080 \text{ kN}$
8. The structural arrangement that transfers a building's gravity and lateral loads safely to the foundation.
9. Load-bearing wall systems and skeletal (frame) systems.
10. Columns and beams; the walls become non-structural infill or cladding.

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