

# What is Material Properties and Selection?

## Worksheet

Material properties and selection means evaluating a material's mechanical, physical, and aesthetic properties - such as strength, density, durability, and cost - to choose the best fit for a building's structural and design needs.

## Questions

1. A material has a strength of 200 MPa and a density of 4 g/cm. What is its specific strength?  
A) 50 MPacm/g  
B) 800 MPacm/g  
C) 204 MPacm/g  
D) 196 MPacm/g
2. Which property best measures how much a material weighs for a given strength?  
A) Thermal conductivity  
B) Specific strength  
C) Color  
D) Surface texture
3. Why might an architect choose timber over steel for a low-carbon project?  
A) Timber is always stronger  
B) Timber has lower embodied carbon and stores carbon  
C) Timber never burns  
D) Timber is always cheaper
4. Two materials have the same strength, but Material A is denser than Material B. Which has the higher specific strength?  
A) Material A  
B) Material B  
C) They are equal  
D) Cannot be determined
5. Structural steel has a yield strength of about 350 MPa and a density of 7.85 g/cm. Find its specific strength.
6. A grade of structural timber has a strength of 40 MPa and a density of 0.5 g/cm. Compare its specific strength to the steel above.
7. Aluminum alloy used in facade framing has a yield strength of 270 MPa and density 2.7 g/cm. Find its specific strength.
8. Define: What is material selection in architecture?
9. Define: What is specific strength?
10. Define: Why does density matter for material choice?

## Answer Key

1. A)  $50 \text{ MPacm/g}$  - Specific strength =  $\frac{200}{4} = 50 \text{ MPacm/g}$ .
2. B) Specific strength - Specific strength (strength density) captures the strength-to-weight trade-off.
3. B) Timber has lower embodied carbon and stores carbon - Timber is a renewable material with lower embodied carbon and it sequesters carbon while growing.
4. B) Material B - Specific strength = strength/density; with equal strength, the lower-density material (B) has the higher specific strength.
5. Specific strength =  $\frac{350}{7.85} = 44.6 \text{ MPacm/g}$
6. Specific strength =  $40 / 0.5 = 80 \text{ MPacm/g}$   $80 > 44.6$ , so this timber is stronger per unit weight than the steel example
7. Specific strength =  $270 / 2.7 = 100 \text{ MPacm/g}$
8. Choosing a building material by weighing its strength, density, durability, cost, and appearance against the project's needs.
9. Strength divided by density - a material's strength relative to its own weight, useful for comparing lightweight efficiency.
10. Denser materials add self-weight to the structure, increasing foundation loads and often construction cost.

### **Bounlu**

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