

What Are Thermal Performance Standards?

Worksheet

Thermal performance standards regulate how much heat can pass through a building element, expressed as the U-value; heat loss is calculated as $Q = U A T$, where lower U-values mean better insulation.

$$Q = U \cdot A \cdot \Delta T$$

Questions

1. What does the U-value represent?

- A) Total heat lost by a whole building
- B) Heat transfer rate per m per degree of temperature difference
- C) The R-value of insulation only
- D) Air infiltration rate

2. A wall with $U=0.2$ W/mK, $A=10$ m, $T=25$ K loses how much heat?

- A) 50 W
- B) 500 W
- C) 5 W
- D) 0.5 W

3. How does U-value relate to R-value?

- A) $U = R$
- B) $U = R$
- C) $U = 1/R$
- D) $U = R/2$

4. Why do building codes cap U-values?

- A) To increase energy consumption
- B) To limit unwanted heat flow and reduce energy use
- C) To maximize window area
- D) To eliminate insulation requirements

5. A wall has $U = 0.25$ W/mK, area 15 m, and an indoor-outdoor temperature difference of 22 K. Find the heat loss.

6. A poorly insulated window ($U = 2.8$ W/mK) has an area of 2 m with $T = 18$ K. Compare its heat loss to a well-insulated window ($U = 1.0$ W/mK).

7. A roof must not lose more than 300 W with $A = 100$ m and $T = 20$ K. What is the maximum allowable U-value?

8. Define: What does U-value measure?

9. Define: How is U-value related to R-value?

10. Define: What does a lower U-value mean?

Answer Key

1. B) Heat transfer rate per m per degree of temperature difference - U-value (W/mK) is the standardized measure of heat flow through an element per unit area and temperature difference.
2. A) $50 \text{ W} - Q = 0.2 \cdot 10 \cdot 25 = 50 \text{ W}$.
3. C) $U = 1/R$ - U-value is the reciprocal of total thermal resistance.
4. B) To limit unwanted heat flow and reduce energy use - Thermal performance standards keep heating/cooling energy demand low by limiting envelope heat transfer.
5. $Q = U \cdot A \cdot T \cdot Q = 0.25 \cdot 15 \cdot 22 \cdot Q = 82.5 \text{ W}$
6. Poor: $Q = 2.8 \cdot 2 \cdot 18 = 100.8 \text{ W}$ Good: $Q = 1.0 \cdot 2 \cdot 18 = 36 \text{ W}$ The poorly insulated window loses about 2.8 more heat.
7. $Q = U \cdot A \cdot T \cdot 300 = U \cdot 100 \cdot 20 \cdot U = 300 / 2000 = 0.15 \text{ W/mK}$
8. The rate of heat transfer through a building element per unit area per degree of temperature difference (W/mK).
9. U-value is the reciprocal of total thermal resistance: $U = 1/R_{\text{total}}$.
10. Better insulation - less heat escapes (or enters) through the element.

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