What is Natural Ventilation?

Worksheet

Natural ventilation is airflow driven by wind pressure and the stack effect (temperature-driven buoyancy) rather than mechanical fans, using operable openings positioned to draw fresh air in and push stale air out.

Questions

1. Natural ventilation driven by temperature differences is called

A) Cross-ventilation
B) Stack effect
C) Mechanical ventilation
D) Infiltration

2. Cross-ventilation requires

A) A single window
B) Openings on two opposite sides of a space
C) Mechanical fans
D) No windows at all

3. In Q = CdA(2ghT/T), doubling h (height between openings) makes Q

A) Double
B) Increase by 2
C) Stay the same
D) Halve

4. Which space type benefits most from stack ventilation?

A) A single-story shed with no height variation
B) A tall atrium with high and low openings
C) A sealed basement
D) A windowless closet

5. An atrium has openings 4 m apart in height, indoor air is 5C warmer than outdoor (293 K outside), Cd=0.65, effective area 2 m. Find the airflow rate.

6. A single-sided room has one window and low outdoor wind. Explain why stack ventilation still works.

7. Doubling the opening area A, how does airflow rate change (all else equal)?

8. Define: What two forces drive natural ventilation?

9. Define: What is the stack effect?

10. Define: What building feature maximizes stack ventilation?

Answer Key

1. B) Stack effect - Stack effect is buoyancy-driven airflow caused by indoor-outdoor temperature (density) differences.

2. B) Openings on two opposite sides of a space - Cross-ventilation needs inlet and outlet openings on opposite (or different) facades so wind pressure pushes air through.

3. B) Increase by 2 - Q depends on h, so doubling h increases Q by a factor of 2 1.41.

4. B) A tall atrium with high and low openings - Stack ventilation needs vertical height between low inlets and high outlets - atriums are ideal.

5. Q = CdA(2ghT/T) Q = 0.652(29.8145/293) Q = 1.3(1.339) Q 1.31.157 1.50 m/s

6. No wind cross-ventilation pressure 0 Warm indoor air rises and exits near the top of the window Cooler outdoor air enters near the bottom Net result: buoyancy-driven exchange even in still air

7. Q A (linear relationship in the formula) Doubling A Q doubles Example: A=2Q=1.5 m/s; A=4Q=3.0 m/s (same Cd, h, T, T)

8. Wind pressure (cross-ventilation) and buoyancy from temperature differences (stack effect).

9. Warm air rises and escapes through high openings, drawing cooler air in through low openings - driven by temperature (density) difference.

10. Vertical height between low inlets and high outlets, such as atriums, stairwells, or solar chimneys.