Attic Temperature by Steady Heat Balance

Unheated attic or roof-space temperature from the heat flows through the ceiling and the roof and the attic ventilation, with the ceiling heat loss.

Method: Heat balance of an unconditioned space

Input parameters

Unit system: SI

Parameter	Value	Unit
Ceiling U-value	0.25000	W/(m²·K)
Ceiling area	120.00	m²
Roof U-value (attic to outside)	3.0000	W/(m²·K)
Roof area	140.00	m²
Attic ventilation airflow	180.00	m³/h
Indoor temperature	21.000	°C
Outdoor (or roof sol-air) temperature	-5.0000	°C

Calculated results

Parameter	Value	Unit
Attic temperature	-3.4717	°C
Heat flow through the ceiling	734.15	W
Heat removed by attic ventilation	92.250	W
Heat lost through the roof	641.90	W

Notes for this case

• Steady state: heat entering the attic through the ceiling equals that leaving through the roof and with the ventilation air, so T_a = (U_cA_cT_i + U_rA_rT_o + ρc_pV̇T_o)/(U_cA_c + U_rA_r + ρc_pV̇). In summer use the roof's sol-air temperature for T_o to include solar gain. The ceiling heat loss then uses the attic temperature instead of outdoor temperature. Air density × c_p is taken as 1.2 × 1006 J/m³·K.

Formula and method

$$T_a = \frac{U_c A_c T_i + (U_r A_r + \rho c_p \dot{V}) T_o}{U_c A_c + U_r A_r + \rho c_p \dot{V}}$$

Variables

U_c	Ceiling U-value	W/(m²·K)
A_c	Ceiling area	m²
U_r	Roof U-value (attic to outside)	W/(m²·K)
A_r	Roof area	m²
$\dot{V}$	Attic ventilation airflow	m³/s
T_i	Indoor temperature	K
T_o	Outdoor (or roof sol-air) temperature	K
T_a	Attic temperature	K
Q_c	Heat flow through the ceiling	W
Q_v	Heat removed by attic ventilation	W
Q_r	Heat lost through the roof	W

Method and standards

Attic temperature.

Assumptions and limits

- Steady state; uniform attic temperature; constant air properties.

References

Heat balance of an unconditioned space

Report details

Report reference	FCC-FAGH-SHX0 (the same inputs always give the same reference)
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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/hvac/loads/attic-temperature-balance

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.