Building Fabric Heat Loss (U × A × ΔT)

Heat loss or gain through walls, roof, floor and windows from U-values, areas and the indoor–outdoor temperature difference, with the yearly energy from degree-days.

Method: Steady-state conduction Q = U A ΔT; Degree-day method

Input parameters

Unit system: SI

Parameter	Value	Unit
U-value of the walls	0.60000	W/(m²·K)
U-value of the roof	0.40000	W/(m²·K)
U-value of the floor	0.50000	W/(m²·K)
U-value of the windows	2.8000	W/(m²·K)
Area of the walls	300.00	m²
Area of the roof	200.00	m²
Area of the floor	200.00	m²
Area of the windows	60.000	m²
Indoor temperature	21.000	°C
Outdoor design temperature	5.0000	°C
Degree-days for the season (K·day, 0 = none)	1,500.0	

Calculated results

Parameter	Value	Unit
Through the walls	2.8800	kW
Through the roof	1.2800	kW
Through the floor	1.6000	kW
Through the windows	2.6880	kW
Total fabric heat loss (negative = heat gain)	8.4480	kW
Fabric heat loss coefficient	0.52800	kW/K
Seasonal fabric heat loss	19,008	kWh

Notes for this case

- Fabric only: add ventilation and infiltration (see the ventilation heat load calculator) and thermal bridges for the full load.

Formula and method

$$Q_i = U_i A_i (T_i - T_o)$$

$$\Sigma UA = \sum U_i A_i, \quad Q = \Sigma UA\,(T_i - T_o)$$

$$E = \Sigma UA \cdot DD \cdot 86\,400\ \mathrm{s}$$

Variables

U_1	U-value of walls	W/(m²·K)
U_2	U-value of roof	W/(m²·K)
U_3	U-value of floor	W/(m²·K)
U_4	U-value of windows	W/(m²·K)
A_1	wall area	m²

A_2	roof area	m²
A_3	floor area	m²
A_4	window area	m²
U_i	U-value of element i	W/(m²·K)
A_i	area of element i	m²
T_i	indoor temperature	K
T_o	outdoor temperature	K
DD	degree-days	K·day
Q_1	through walls	W
Q_2	through roof	W
Q_3	through floor	W
Q_4	through windows	W
Q_i	through element i	W
Q	Total fabric heat loss (negative = heat gain)	W
ΣUA	fabric heat loss coefficient	W/K
E	seasonal fabric heat loss	J

Method and standards

Steady conduction through each element is U A ΔT; the sum gives the fabric load. Seasonal energy uses degree-days, the sum over the season of the daily temperature difference below the base temperature.

Assumptions and limits

- Steady state; no solar or internal gains; fabric only.
- When outdoor is warmer than indoor the losses come out negative (gains). The seasonal energy is ΣUA times whatever degree-days you enter: heating degree-days for heating, cooling degree-days for cooling.

References

- Steady-state conduction Q = U A ΔT
- Degree-day method

Report details

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Calculator	Building Fabric Heat Loss (U × A × ΔT)
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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/building-fabric-heat-loss

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.