Ventilation and Fresh Air Heat Load

Sensible, latent and total load of outdoor air brought into a room, from air changes per hour or fresh-air flow and the outdoor and indoor conditions.

Method: ASHRAE Handbook—Fundamentals ch. 1 Psychrometrics

Input parameters

Unit system: SI

Parameter	Value	Unit
Room volume	600.00	m³
Air changes per hour	2.0000	
Outdoor dry bulb	38.000	°C
Outdoor relative humidity	45.000	%
Indoor dry bulb	24.000	°C
Indoor relative humidity	50.000	%
Barometric pressure (absolute)	101.33	kPa
Fresh-air flow (0 = use the air changes) Enter a known fresh-air flow (outdoor state) to use it instead of volume × air changes.	0	m³/h

Calculated results

Parameter	Value	Unit
Total load (positive = cooling)	14.296	kW
Sensible load	5.2581	kW
Latent load	9.0379	kW
Outdoor air flow	1,200.0	m³/h
Dry-air mass flow	1,321.3	kg/h

Notes for this case

- Infiltration through doors and leaks adds to this; a negative load means the outdoor air heats or humidifies the room.

Formula and method

$$\dot{V}_o = \frac{n\,V_r}{3600} \text{ or } \dot{V}_f \qquad \dot{m}_{da} = \frac{\dot{V}_o}{v_o} \qquad \dot{Q}_t = \dot{m}_{da}(h_o - h_i) \qquad \dot{Q}_s = \dot{m}_{da}\,[h(T_o, W_i) - h_i] \qquad \dot{Q}_l = \dot{Q}_t - \dot{Q}_s$$

Variables

V_r	room volume	m³
n	air changes per hour	1/h
T_o	outdoor dry bulb	K
φ_o	outdoor RH	–
T_i	indoor dry bulb	K
φ_i	indoor RH	–
p	barometric pressure	Pa
$\dot{V}_f$	fresh-air flow at the outdoor state (used instead of n V_r when above 0)	m³/s
$\dot{Q}_t$	total load	W
$\dot{Q}_s$	sensible load	W
$\dot{Q}_l$	latent load	W

$\dot{V}_o$	outdoor air flow	m³/s
$\dot{m}_{da}$	dry-air flow	kg/s
h_o, h_i	outdoor and indoor enthalpy	J/kg
W_i	indoor humidity ratio	kg/kg
v_o	outdoor specific volume	m³/kg

Method and standards

Energy balance on the outdoor air brought to room conditions, with ASHRAE moist-air enthalpy.

Assumptions and limits

- The outdoor air flow is n V_r/3600 from the air changes, or the fresh-air flow entered (at the outdoor state) when that is above zero.
- Steady state; the outdoor air is fully brought to room conditions.

References

• ASHRAE Handbook—Fundamentals ch. 1 Psychrometrics

Report details

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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/ventilation-heat-load

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.