Outdoor (Fresh) Air Load: Sensible, Latent and Total

Sensible, latent and total cooling load of bringing outdoor ventilation air to room conditions, from air flow, temperatures and humidity ratios.

Method: Sensible and latent air-load equations at standard density

Input parameters

Unit system: SI

Parameter	Value	Unit
Outdoor air flow	500.00	L/s
Outdoor dry bulb	35.000	°C
Room dry bulb	24.000	°C
Outdoor humidity ratio	18.000	g/kg
Room humidity ratio	9.3000	g/kg

Calculated results

Parameter	Value	Unit
Sensible load	6.8606	kW
Latent load	13.055	kW
Total load	19.916	kW
Total load in tons	5.6630	TR

Notes for this case

• Ventilation air must be cooled from outdoor to room temperature (sensible load) and dried from outdoor to room humidity ratio (latent load, at about 2,501 kJ per kg of water). Taking standard air density 1.2 kg/m³, a litre per second at 1 K is about 1.2 W sensible. In humid climates the latent part can exceed the sensible, which is why dedicated outdoor-air units and energy recovery pay off. Negative values mean the air helps cool or dry.

Formula and method

$$Q_s = \rho \dot{V}(1006 + 1860 W_o)(T_o - T_i), \quad Q_l = \rho \dot{V} h_{fg}(W_o - W_i)$$

Variables

$\dot{V}$	Outdoor air flow	m³/s
T_o	Outdoor dry bulb	K
T_i	Room dry bulb	K
W_o	Outdoor humidity ratio	kg/kg
W_i	Room humidity ratio	kg/kg
Q_s	Sensible load	W
Q_l	Latent load	W
Q_t	Total load	W
Q_{TR}	Total load in tons	W

Method and standards

Outdoor air load.

Assumptions and limits

- Standard air density; steady state.

References

Sensible and latent air-load equations at standard density

Report details

Report reference	FCC-ZAD1-6M6Y (the same inputs always give the same reference)
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Calculator	Outdoor (Fresh) Air Load: Sensible, Latent and Total
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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/outdoor-air-load

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.