Outdoor Swimming Pool Heat Loss, Solar Gain and Heating Load

Monthly radiation, evaporation and convection losses, solar gain and heating load of an outdoor pool, with the effect of a film or bubble cover at night.

Input parameters

Unit system: SI

Parameter	Value	Unit
Pool surface area	72.000	m²
Pool temperature	25.000	°C
Monthly mean air temperature	16.000	°C
Monthly mean relative humidity	70.000	%
Air pressure	101.33	kPa
Wind speed at the pool (1/5–1/10 of the weather-station value)	3.0000	m/s
Monthly average daily radiation on a horizontal surface	19.100	MJ/m²
Monthly clearness index (weighting of sky temperature)	53.000	%
Surface transmittance	92.000	%
Pool absorptance (0.6 to 0.9)	60.000	%
Days in the month	30.000	
Share of the time covered	50.000	%
Cover type	Bubble cover (stops evaporation, cuts convection)	

Calculated results

Parameter	Value	Unit
Dew point	10.538	°C
Mean sky temperature	7.7381	°C
Solar energy absorbed	22.773	GJ
Radiation loss	17.748	GJ
Evaporation loss (uncovered)	44.753	GJ
Convection loss (uncovered)	19.855	GJ
Heating load, never covered	59.583	GJ
Heating load with the cover	27.279	GJ

Notes for this case

• Wei et al. (1979) evaporation and convection equations in W/m² with the pressure in kPa; the pool radiates as a black body to a sky temperature weighted by K̄_T between clear sky (Berdahl and Martin) and air. A negative load means the pool would warm above the set point.

Formula and method

$$q_e = P_a[35V + 43(T_p - T_a)^{1/3}](\omega_p - \omega_a), \quad q_c = q_e\, 0.0006\frac{T_p - T_a}{\omega_p - \omega_a}$$

$$Q_r = A\sigma(T_p^4 - \bar{T}_{sky}^4)\Delta t, \quad Q_s = A\bar{H}\tau\alpha N$$

Variables

A	Pool surface area	m²
T_p	Pool temperature	K
$\bar{T}_a$	Monthly mean air temperature	K
ϕ	Monthly mean relative humidity	-
P_a	Air pressure	Pa
V	Wind speed at the pool (1/5–1/10 of the weather-station value)	m/s
$\bar{H}$	Monthly average daily radiation on a horizontal surface	J/m²
$\bar{K}_T$	Monthly clearness index (weighting of sky temperature)	-
τ	Surface transmittance	-
α	Pool absorptance (0.6 to 0.9)	-
N	Days in the month	-
f_c	Share of the time covered	-
cover	Cover type	-
T_{dp}	Dew point	K
$\bar{T}_{sky}$	Mean sky temperature	K
Q_s	Solar energy absorbed	J
Q_r	Radiation loss	J
Q_e	Evaporation loss (uncovered)	J
Q_c	Convection loss (uncovered)	J
L_0	Heating load, never covered	J
L	Heating load with the cover	J

Method and standards

Monthly energy balance of an outdoor pool.

Assumptions and limits

- Monthly averages; empirical evaporation equation.

Report details

Report reference	FCC-4WDA-FWC6 (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/environmental/solar-thermal/swimming-pool-heat-loss

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Reopens the calculator with the inputs of this report.