Ground-Source Heat Pump Borehole Length

Ground heat load, total borehole length and number of boreholes for a ground-source heat pump from heating capacity, COP and a specific heat extraction rate.

Method: Specific heat-extraction sizing of borehole heat exchangers

Input parameters

Unit system: SI

Parameter	Value	Unit
Heat pump heating capacity	12.000	kW
Coefficient of performance	4.0000	
Specific heat extraction rate of the ground (W per m of borehole)	50.000	W/m
Maximum depth per borehole	100.00	m
Full-load hours per year	1,800.0	h

Calculated results

Parameter	Value	Unit
Heat extracted from the ground	9.0000	kW
Total borehole length	180.00	m
Number of boreholes	2.0000	
Heat extracted per year	16.200	MWh
Annual extraction per metre (kWh/m)	90.000	
Compressor electrical power	3.0000	kW

Notes for this case

• Q_g = Q_h(1 − 1/COP); L = Q_g/q'. Rule-of-thumb extraction rates are about 20–30 W/m in dry sediments, 50–60 W/m in water-saturated rock and up to 80 W/m in good crystalline rock for about 1,800–2,400 full-load hours. Large or unbalanced systems need a thermal response test and a simulation.

Formula and method

$$\dot{Q}_g = \dot{Q}_h\left(1 - \frac{1}{COP}\right), \quad L = \frac{\dot{Q}_g}{q'}, \quad n = \left\lceil \frac{L}{H} \right\rceil$$

Variables

$\dot{Q}_h$	Heat pump heating capacity	W
COP	Coefficient of performance	-
q'	Specific heat extraction rate of the ground (W per m of borehole)	W/m
H	Maximum depth per borehole	m
t_{fl}	Full-load hours per year	s
$\dot{Q}_g$	Heat extracted from the ground	W
L	Total borehole length	m
n	Number of boreholes	-
E_g	Heat extracted per year	J
E_g/L	Annual extraction per metre (kWh/m)	-
P_{el}	Compressor electrical power	W

Method and standards

Borehole field sizing.

Assumptions and limits

- Heating-dominated load; rule-of-thumb extraction rate.

References

Specific heat-extraction sizing of borehole heat exchangers

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/environmental/geothermal-ocean/gshp-borehole-length

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.