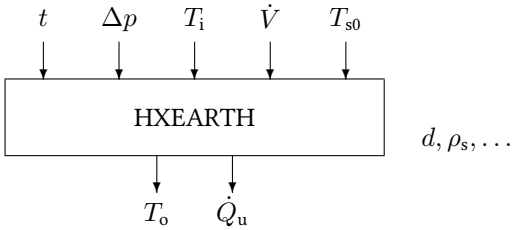
Block HXEARTH

The HXEARTH block calculates the outlet temperature of a part of a system of parallel horizontal groundheat collectors, taking into account the influence of the ground surface temperature and the groundwater level.





Name	HXEARTH
Function	st0031
Inputs	5
Outputs	2
Parameters	18
Strings	0
Group	S

Inputs

1 Time t / s
2 Pressure loss of the system Δp / Pa
3 Inlet air temperatur T_i / °C
4 Total mass flow $\dot{V}$ / m^3/s
5 Undisturbed soil temperature $T_{\mathrm{s}0}$ / °C

Outputs

1 Outlet air temperature T_o / °C
2 Useful heat $\dot{Q}_\mathrm{u}$ / W

Parameters

1 Depth of the tube below ground d / m
2 Soil density ρ_s / $\mathrm{kg\,m^{-3}}$
3 Heat capacity of the soil c_p / $\mathrm{J\,kg^{-1}\,K^{-1}}$
4 Heat conductivity of the soil λ / $\mathrm{W\,m^{-1}\,K^{-1}}$
5 Tube radius r / m
6 Total tube length l / m

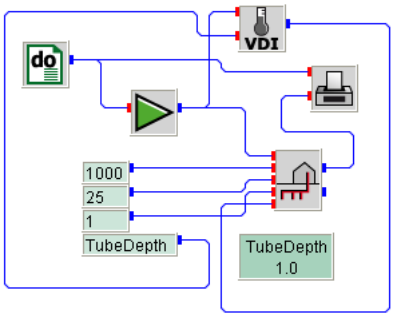
7 Fan efficiency η_F (usually between 0.3 and 0.9)
8 Fan position
  0 At entrance
  1 At exit of the tube
  2 No fan
9 Depth of influence of hourly temperature changes d_i / m (usually around 0.14 m)
10 Number of segments n
11 Depth of groundwater level d_w / m
12 Overall heat loss coefficient of building wall U / $\mathrm{W\,m^{-2}\,K^{-1}}$
13 Air temperature inside the building T_b / °C
14 Average distance between heat collector and building Δ_b / m
15 Number of tubes in parallel N_p
16 Distance between centers of tubes Δx / m
17 Attenuation factor f
18 Ground temperature phase delay Δd /d

Strings

None

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hxearth.vseit



In this example an earth heat exchanger is simulated with the following parameters:

Depth of the tube below ground	TubeDepth
Soil density	1900
Heat capacity of the soil	900
Heat conductivity of the soil	1.5
Tube radius	0.8
Total tube length	100
Fan efficiency	0.7
Fan position	At tube entrance
Depth of influence of hourly temperature changes	0.14
Number of segments	100
Depth of groundwater level	5
Overall heat loss coefficient of building wall	2.0
Air temperature inside the building	20

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Average distance between heat collector and building      5
Number of tubes in parallel                               2
Distance between centers of tubes                         5
Attenuation factor                                        0.1
Ground temperature phase delay                          150
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The Depth of the tube below ground parameter is set to the value TubeDepth which is a global variable defined to be 1.0, because this parameter is also required by the TSOIL block as input from a CONST block with its parameter set to TubeDepth as well.

Almost all inputs of the HXEARTH block are set constant through CONST blocks. The pressure loss of the system is 1000 Pa, the inlet air temperature is set to 25 °C, and the total air mass flow is 1 m^3/s.

The required soil temperature is calculated by the TSOIL block after DIN 4710 for the region of Mannheim, German.

The simulated time period is 8760 hours as specified by a DO block. Since the HXEARTH block expects the time signal in seconds, a GAIN block is used to convert the hour signal of the DO block to the second of the year. A PLOT block displays the outlet air temperature of the earth heat exchanger as a function of the hour of the year.

