Study on Energy Foundation Design in South Louisiana

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Research Objective

- A case study of Geothermal energy output using typical pile foundation in South Louisiana.
- A comparison of annual HVAC (Heating, venting and air conditioning) cost between geothermal energy with other common source of energy.
- Comparison of CO_2 emission by geothermal energy with other energy sources.

Methodology

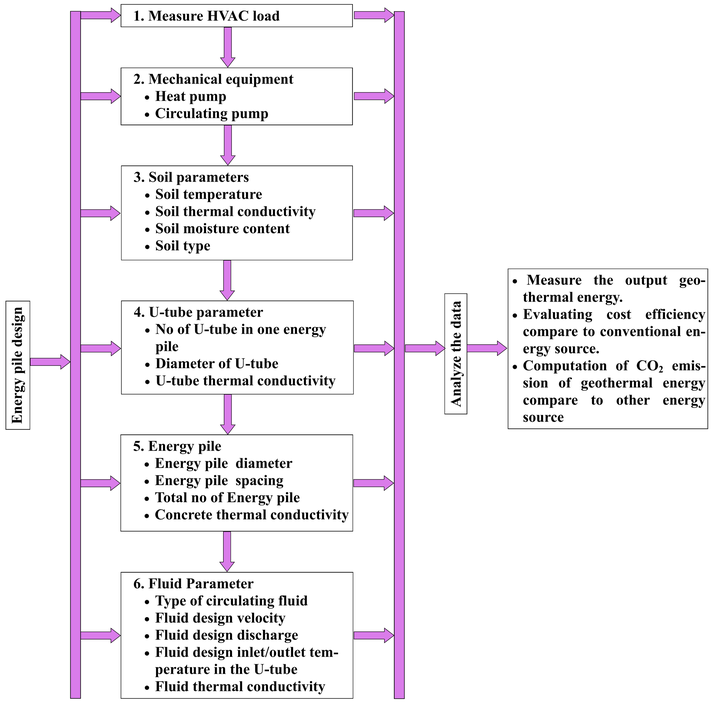

Fig 1. A flowchart of design procedure in the case study

Building description

- Four story building.
- Each of the upper floors provides 696.77 m^2 (7,500 ft^2) of office space.
- The building is supported by 0.33 m (12.75 in) diameter open-ended steel H piles with a wall thickness of 0.0064 m (0.25 in).
- The design compressive capacity of the pile foundation is 498.2 kN (50 tons) and the tensile capacity is 249.1 kN (25 tons).
- According to the consultant provided geotechnical report, a pile depth of 24.384 m (80 feet) is used.

Schematic diagram of an energy pile

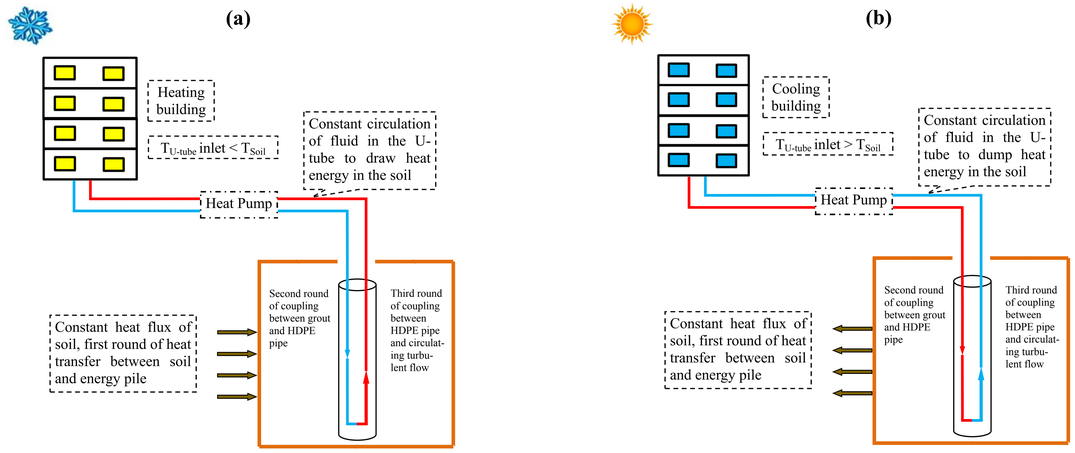

Fig 2. Schematic diagram of energy pile heat exchanger in (a) winter and (b) summer

Table 1. Summary of design parameters

Building Location	New Orleans
Total number of energy pile	16
Energy pile spacing	8.55m (28.06´)
Soil temperature	19.44^{0}C (67^{0}F)
Fluid inlet temperature	47.06^{0}C (116.7^{0}F)
Fluid outlet temperature	3^{0}C (37.4^{0}F)
Fluid circulation pump	1492-Watt (2 HP) , 85% efficient
Fluid type	Water (100% by weight)
Fluid discharge	0.757×10^{-3} m^3/s (12gpm)
Minimum fluid velocity	0.61 m/s (2 fps)
U-tube type	SDR 11 (40 mm)
No of U-tube	One U-tube in one energy pile
Energy pile diameter	0.33m (12.75in)
Annual running time for cooling load at peak load	21.89%
Annual running time for heating load at peak load	57%

Table 2. HVAC load of the building using the LEED Plus software

Floor	Cooling Load (kW/hr)	% of run time in cooling mode	Heating Load (kW/hr)	% of run time in heating mode
2nd ,3rd and 4th	147.27	21.9	39.54	57

Results and discussion

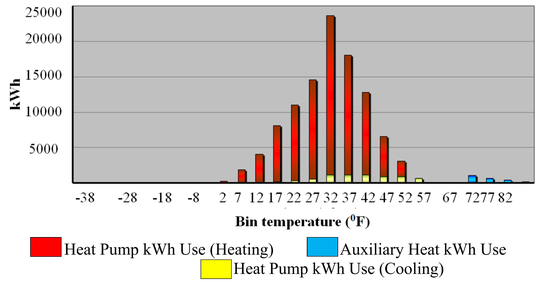

Fig 3. Annual energy consumption

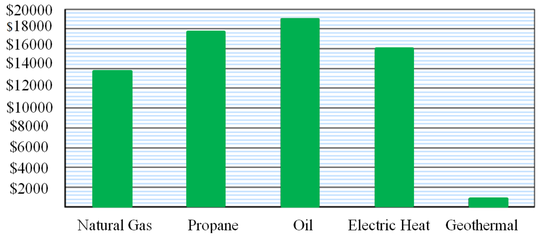

Fig 4. Comparison of HVAC cost

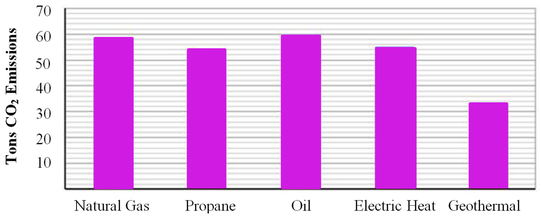

Fig 5. Comparison of annual CO_2 emission

Table 3. Total output of energy pile

Cooling load (kW/hr)	Max Demand	147.27
	Extraction from Energy Pile	29.31
	%	19.90
Heating load (kW/hr)	Max Demand	39.54
	Extraction from Energy Pile	26.93
	%	68.12

Acknowledgements

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