Installing vertical ground heat exchangers on a commercial geothermal system project

Most Building Owners wanting a Geothermal Heat Pump System don't get one.

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Mechanical engineers tend to be risk adverse...with good reason. If the systems they design don't work they are liable and their insurance rates will probably take a hit. So if you want a geothermal heat pump system in your new building project the chances are many engineering firms will either suggest “those systems don’t work”, or “they’re so expensive you’ll never get a payback”.

But if the designer knows how to optimize the building and building systems to work well with a ground heat exchanger (GHX), the cost premium for the system should be about $3.00 to $5.00 / ft2 of building ($32 - $53 / m2). Depending on the cost of natural gas or other fuels available and the cost of electricity, the simple payback of a well-designed system should be in the range of 3 – 8 years.

It’s worth remembering that many commercial buildings, even those in cold climates (I’m from Winnipeg where -40° is not uncommon) can be “cooling dominant”. That means more heat is rejected to the GHX annually than is taken from it and that the GHX will tend to warm up over time (unless steps are taken to avoid that), and heating efficiency will improve. It also implies that cooling loads are greater than heating loads and that cooling efficiency and cooling energy costs need to be considered.

“Optimization” is not the same as “value engineering”. Often, when builders want to reduce the cost of the system, what they mean when they say value engineering, is how much they can cut out of the system but still be able to meet the peak heating and cooling requirements. Optimization is finding ways to improve the building envelope, select glass or lighting that will reduce cooling loads, or considering things like energy recovery on the ventilation air to change the building loads so that the size and cost of the GHX can be reduced and at the same time operate at temperatures that allow the heat pumps to work more efficiently.

When considering optimization strategies, cost of the building or building systems might increase...but the size and cost of the GHX will be reduced enough to offset the additional costs in the building. Engineering firms don’t want to reduce the cost of the mechanical systems. That’s because their fees are often a percentage of the cost of the mechanical system...creating an incentive to make the system as expensive as they think the building owner will bear. They’d rather see a system with 100 boreholes at a cost of $1 million than a system that’s been optimized and the cost is only $600 thousand.

There’s definitely more work involved in designing and implementing a ground source heat pump system than a conventional system. More detailed energy modeling is needed when designing a geo heat pump system, and often numerous iterations of the energy model are needed to find the right solution. There’s additional work in designing the GHX in on top of the building system. Quality assurance / quality control programs and commissioning requirements of the GHX needs be more rigorous... since the expensive GHX is buried, sometimes under the building and it’s difficult or impossible to change or repair. And the building owner or operator needs training and a more detailed operating manual because operating these systems is a little different than operating a conventional system. And a designer should be charging more for designing a ground source heat pump system than a conventional system...but perhaps a percentage of cost of building a system is perhaps not the right approach if you want an optimized system.

If it sounds more complicated designing a ground source system, that’s because it is. It sometimes requires “outside the box” thinking when looking for heat sources or heat sinks to balance energy loads to or from the ground. I’ve seen snow melt systems used to get rid of excess heat. Or rejecting heat from computer server rooms or restaurant coolers into the GHX rather than an air cooled condenser. Or integrating thermal energy storage into the system to reduce peak heat rejection to the GHX.

I’ve found it’s a lot more fun than simply changing the title blocks from the last set of drawings! And I’ve had the opportunity to work on some pretty interesting projects.
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