

# Borefield design software

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Borefield design software offers precise solutions for optimizing geothermal systems. Unlike empirical rules, software tools provide tailored simulations, ensuring optimal performance, cost-efficiency, and risk mitigation. Check out the article for more information on why to use borefield design software instead of rules of thumb for your next borefield project.

## Rules of thumb

Like in any other HVAC-field, there are a lot of different ways to engineer a system. The geothermal domain is no different. When looking at literature, there are four different levels of borefield sizing accuracy mentioned, ranging from linear rules of thumb to hourly simulations. The latter is, of course, the most accurate, but often in practice, rules of thumb are used for borefield sizing. These rules come in the form of a specific power per borehole length (such as 30W/m borehole) and offer the designer a quick way to size a system, by just dividing the required peak load by this factor.

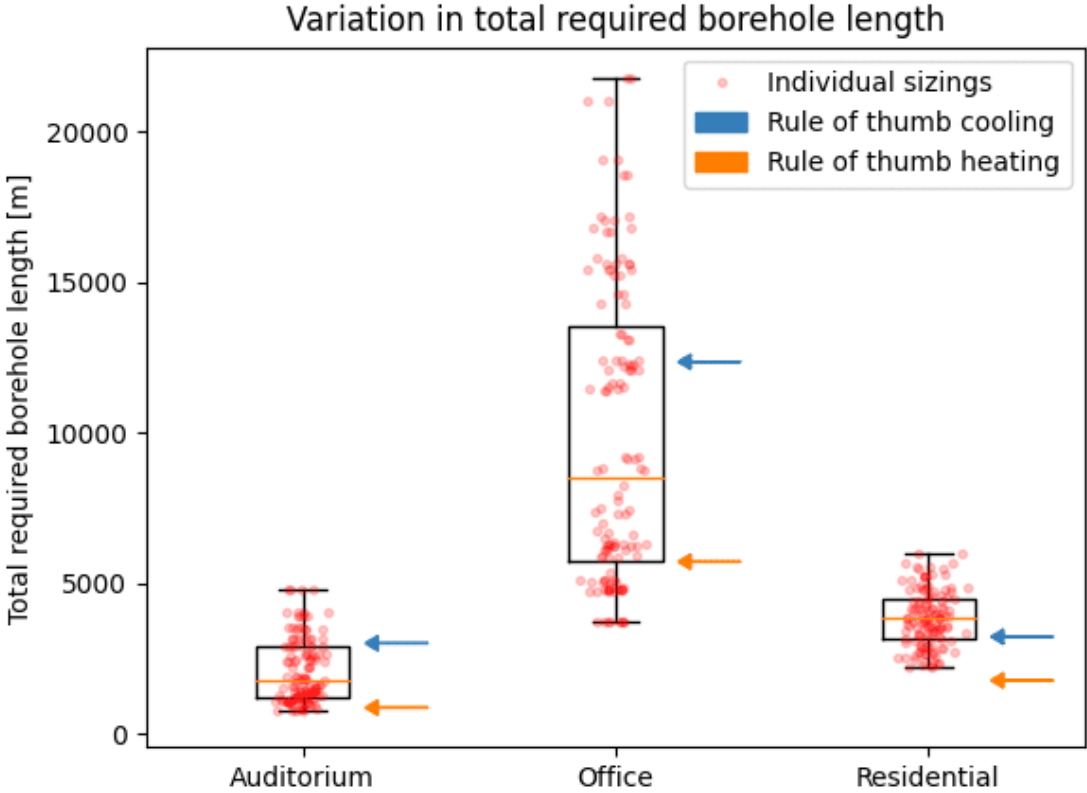
However, what are the important criteria that gave rise to this constant value? Is it for a shallow or a deeper borefield? Is it designed to work with peak heating or also for peak cooling? Does it assume laminar or turbulent flow? Am I over or under sizing my borefield?

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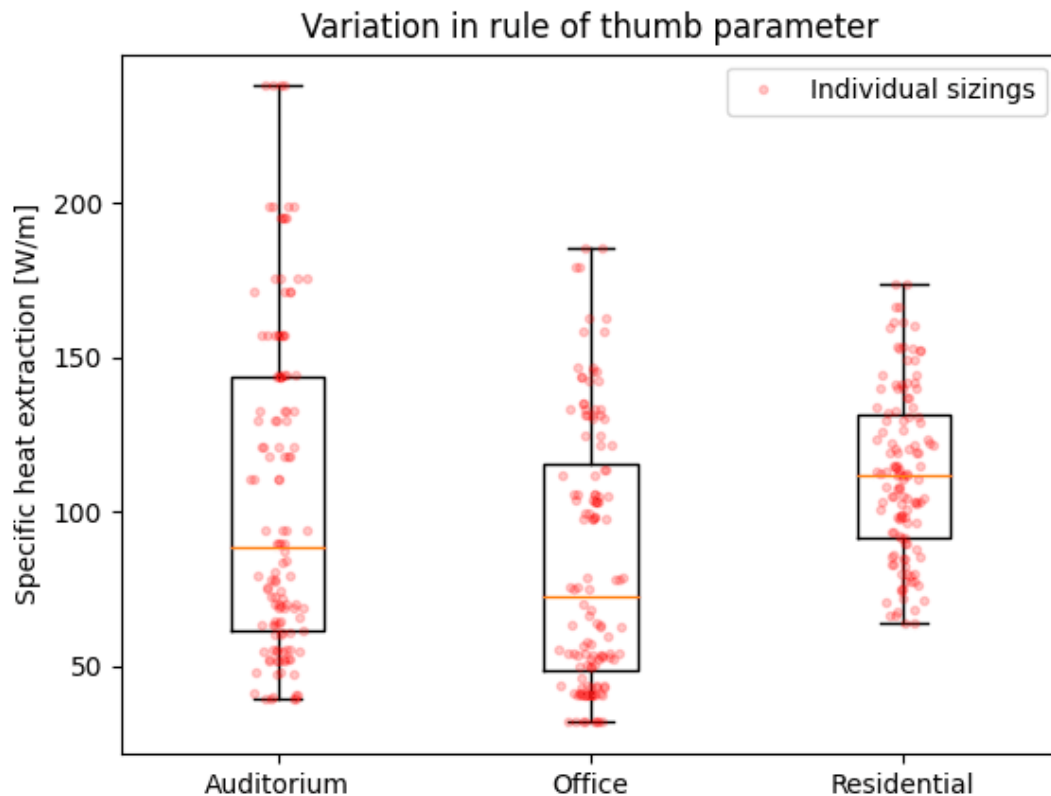
When designing a geothermal borefield, numerous decisions must be made. Not only must you determine the total required borehole length, but also the borefield configuration, depth, and borehole internals. Parameters such as fluid regime (laminar or turbulent) are particularly crucial for your final design. With specialized design software like GHEtool Cloud, you can input all these project-specific parameters and calculate the number of boreholes required. This ensures your borefield is consistently sized correctly and, therefore, economically optimized. The disparities between a result derived from a rule of thumb versus one from borefield design software can be quite significant.

## Comparison between tools and rules of thumb

To illustrate the contrasting design outcomes between sizing with rules of thumb and GHEtool Cloud, a comprehensive analysis was conducted. Three diverse buildings—an auditorium, an office, and a multi-family residential building—were dynamically simulated with an hourly resolution to capture their varied thermal demands accurately. Subsequently, these hourly heating and cooling demand profiles were utilized as inputs for GHEtool to size the borefield across numerous scenarios. These scenarios encompassed factors such as laminar or turbulent flow, varying grout thermal conductivity, and deep or shallow drillings, among others. Each simulation is represented as a distinct red dot in the figures provided below, showing the range of design possibilities and the significant impact of utilizing GHEtool for precise borefield sizing.



All the red dots depicted in the figures above represent accurately sized borefields, with variations stemming from differences in design inputs. When comparing the range of potential sizes obtained through GHEtool with the single value derived from a rule of thumb, it becomes evident that the latter offers minimal insight into the accuracy and robustness of borefield design.



Upon reverse engineering the rule of thumb, the underlying reason becomes apparent: the specific heat extraction ranges from 30 to 230W/m. This wide range underscores the inadequacy of rule-of-thumb approaches in providing meaningful guidance for optimal borefield design.

## Conclusion

The total required borehole length is a highly sensitive parameter, contingent upon factors such as the building structure, soil conditions, and various design criteria concerning borehole internals. It's impossible to determine beforehand whether a rule of thumb will result in a significantly over- or undersized borefield. For more robust and economically feasible designs, even in an early stage, it's advisable to utilize a borefield design software like [GHEtool Cloud](#).

## Reference

- This article is based on a publication in the IEA Magazine. Check it out [here](#).