

Integration of Geoscience into Geothermal Bore Field Design

Kevin Amende, P.E.
Department of Mechanical & Industrial Engineering
Montana State University

Today's technological advancements play an important role in the way our society gathers and disseminates information amongst itself. As educators, we must be creative in both our pedagogy and how we integrate content from various disciplines into our courses. Once students enter the workforce they will be challenged to function within multidisciplinary teams to solve real world problems. This specifically holds true for the engineering and geoscience disciplines.

Within civil and environmental engineering it is easy to see how geoscience correlates. However, in mechanical engineering, there are a few distinctly different correlations taking place with geoscience. These primarily reside in the area of heat transfer and energy generation. The engineering courses I teach in heating, ventilation, and air conditioning (HVAC) introduce the topic of ground-source heat pumps. These systems utilize geothermal energy in the form of heat transfer to or from the earth through a liquid. The heat transfer takes place in either open or closed loop systems both affecting the natural state of the soil. When engineers design this type of renewable energy system they need to be able to understand the geology of the soil they are dealing with and how its properties affect the performance of the system. Currently my students utilize soil classification tables and design standards published by the International Ground-Source Heat Pump Association (IGSHPA) to estimate the amount of energy that can be transferred through a geothermal bore. In order to gain a better understanding of how to read well logs and interpret formation thermal conductivity tests, engineers must have a greater understanding of geoscience.

One of the approaches I have tried with my students is having a civil engineering professional guest lecture about well logs and how drillings are classified. This approach only provided a limited amount of exposure to geoscience and how it integrates with engineering. As geothermal heat exchange becomes more widely used as a renewable energy source engineers need to have a greater understanding of geoscience. Through this expanded knowledge engineers will have the skills needed to generate good bore field designs that meet their project's heating and cooling demands. If engineers do not adequately understand geoscience there is a good chance they will either oversize a bore field causing unneeded drilling costs or undersize the bore field resulting in not enough heating or cooling for the application.

To strengthen the integration of geoscience into my engineering curriculum I plan on working closely with our earth science and land resource department to develop content both for lecture and laboratory instruction. I propose introducing students to the various drilling processes and how well logs

are developed based on these different methods. Students will learn how to generate a well log and classify the drillings in a laboratory environment. Through hands-on learning the students will gain a deeper understanding of the drilling processes available and how to generate and interpret their well logs. The desired outcome from this experience is intended to increase the students' knowledge needed to design and size geothermal bore fields.