Lily List

Math 140 G

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Differential Calculus in Mining Engineering

There are thousands of professions that require extensive use of differential calculus; Mining Engineering is one of them. In order to get a first-hand description of the extent of calculus I would be using, I decided to talk to my advisor, Larry Grayson, one of the very few people dedicated specifically to mining engineering. Before meeting with him, I asked him when I would be applying calculus within my field of study. He described to me three different scenarios; for ventilation simulation, rock mechanic analysis, and mine planning software.

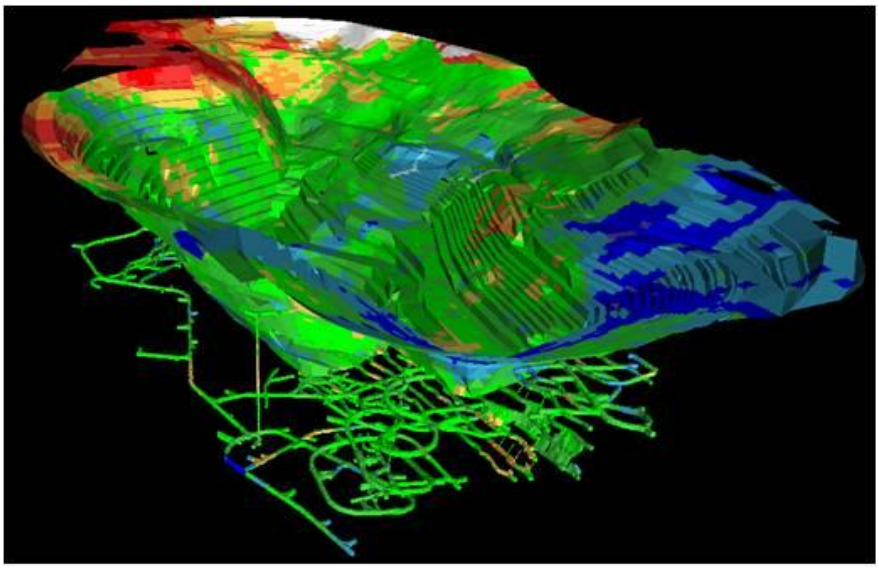
The first example of the use of differential calculus Dr. Grayson provided me with was ventilation simulation. Using hardy-cross algorithms or nonlinear programming, I would be able to determine how to ventilate separate shafts of a mine. Calculus would also tell me how long the mine shaft would stay ventilated enough for a certain amount of people would be able to stay underground while working. The basis of this method is differential calculus in algorithms to reach convergence to optimum value. The use of calculus in this situation is crucial because it deals directly with the health and survival of a miner while in an underground shaft. Understanding the exact amount of time with ample ventilation in a mine shaft is due to differential calculus.

In the second scenario, Dr. Grayson described differential calculus within rock mechanic analysis. He initially mentioned how most of this was built into asoftware that determines everything for the user, however, he reiterated the importance of knowing calculus first hand. For rock mechanics analysis, calculus is used for pillar design in underground mines. This is important because it can

determine the stress points and strain on configuration of underground pillars. Pillars are the main support system for mine shafts and if the calculations are not correct it puts the miners lives in danger.

The third example given was differential calculus in mine planning software. Mining engineers use this software for mostly surface mines. The program uses dynamic programming to determine optimization techniques. Optimization techniques help to optimize pit limits, which outlines the acceptable ore grade that can be mined over the lifetime of a mine. This is relevant because it saves time and money for the mining engineers. Having the benefit of knowing where to dig and the dimensions of where to dig at help eliminate guessing and error. Miners want to mine where the most economically, so they do not waste the company's money.

Overall differential calculus is an essential part of a successful mining engineer. Although in this day and age most of this number crunching can be done through a software, it is important to know how to utilize differential calculus in my field. It is also beneficial to know how to software actually works, through differential calculus. Differential calculus aides mining engineers with ventilation stimulation, rock mechanics analysis and mine planning. These are all very important roles for mining engineers to accomplish efficiently because if done incorrectly, miners, as well as money, could be lost. Differential calculus has demonstrated its importance in the field of mining engineering.

Diagrams

This image represents mine planning software. The way mine planning software works is through differential calculus. It uses non-linear optimizations with constraints to determine the cutoff grade of ore needed. It is important because it helps determine the optimal profit for the company.