McKay Parkinson, Cameron Lusvardi
CE EN 544 Project

2013 Bingham Canyon Landslide

Overview

On April 10, 2013 a massive landslide was triggered at the Bingham Canyon Copper Mine in Utah. This event resulted in the North America's largest non-volcanic landslide with around 165 million tons of material moving at speeds of up to 100 miles per hour. The magnitude from the rumbling of the rock and soil mass was so large that seismic networks in New York detected the slide. While the size of the mass wasting event was unexpected, the timing was not. Kennecott, the company that operates the mine, utilizes interferometric radar systems to detect any slope displacements in the open pit. These displacements are used to calculate strain and can predict the stability of the surface profile. Prior to failure, the operators were alerted of a drastic increase in strain and evacuated the mine. A press release was delivered just seven hours before the collapse notifying the public of the halt in production and the dangerous potential for slope failure. Although no one was hurt from the landslide, major damage disrupted mining operations for months. Fourteen mining trucks and three hydraulic mining shovels were buried in the toe of the slide and major mining roads were swept away. We are unaware of any released official publication or analysis done in collaboration with Kennecott as to the exact details of the slope failure yet we were able to find a few that sought to analyze the case on their own.

Physical Conditions

The Bingham Canyon Copper Mine is the world's deepest open pit mine in the world and produces more than 300,000 tons of copper a year. The geology of the site consists of large layers of quartzite with interbedded hornfels/limestone. The center of the pit contains a large deposit monzonite. Many faults run through or around the mine including the Copper Center Fault, Giant Chief Fault, and Bazook Fault. Smaller faults that may have been highly involved in the shear planes of the slide include the Brooklyn Fault, Manafey fault and the Tunnel Fault. The season was spring which likely left the soil saturated. Relatively small pockets of clay monzonite were intermixed with the larger monzonite deposit at the core of the mine. The quartzite and limestone layers are nearly parallel to the slope of the mine walls which climb at about a 45-degree angle. The depth of the mine analyzed from peak to base was 2893.7 ft.

Slope Stability Analysis

A few 2D and 3D models currently exist to analyze the failure of the Bingham Canyon Copper Mine. However, these models don't take into consideration a calculated factor of safety with varying geotechnical properties. Therefore, we decided to develop a geotechnical profile to analyze the slope failure using UTEXAS. Points were overlaid on a soil profile plot of the mine to define the layers of quartzite, limestone and monzonite. These points were then simplified and matched with their given properties. It is important to note that two landslides occurred on April 10, 2013. The first slide removed enough material on the slope below that likely triggered the second landslide. Only the first slide could be analyzed since we have no knowledge of the topography change in-between events. To determine the depth of the toe and maximum depth of the shear circle of the first slide, distances were calculated from 3D plots of the circular scarps. We then inputted the data into UTEXAS and found that the factor of safety was 0.7 which confirms why Kennecott registered displacements on their radar system from months prior to the slide.

References

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