Numerical Assessment of an Overall Instability at Bajo de La Alumbrera Mine

CIVIL • ENVIRONMENTAL • MANUFACTURING • **MINING** • OIL & GAS • POWER GENERATION

PROJECT DESCRIPTION

Bajo de La Alumbrera Mine

Argentina

3DEC™

Located in Catamarca Argentina, the Bajo de La Alumbrera open pit mine experienced a large-scale instability along its southwestern wall on May 31, 2017. Referred to as the Steve-event, this failure mobilized approximately 700,000 t of rock from the peripheric level (2630 m) to the working area (2169 m) - a height of about 460 m (Figure 1) - interrupting mining for Pushback-12, the last productive mine sector. In 2012, Itasca had conducted predictive *3DEC* numerical analysis on another, more aggressive, slope design, which suggested that a large-scale instability was possible in the same area (Figure 2).

Itasca performed additional numerical modelling analyses to back-analyze the 2017 instability to predict Factor of Safety (FS) contours and consider options to mine the remaining ore at the bottom of the pit.

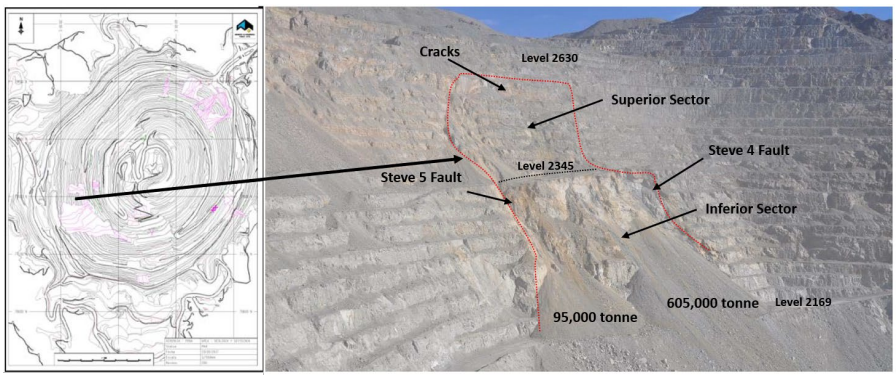


Figure 1. Left: top view showing the instability location. Right: field photo looking to the northwest showing the limits of the instability.

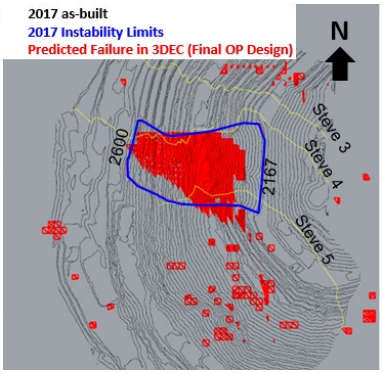


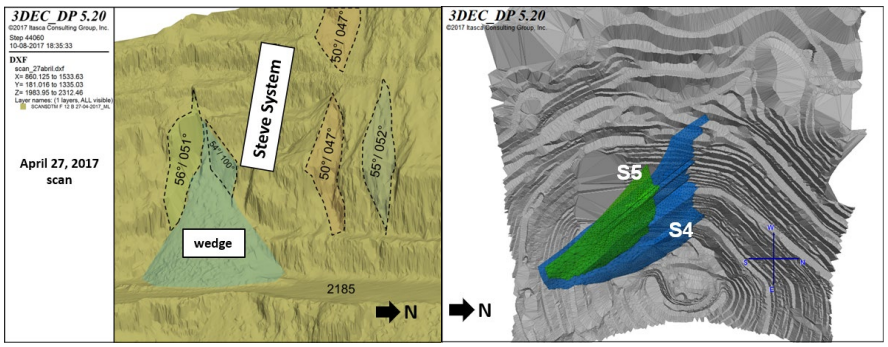
Figure 2. Comparison between the location of the actual instability (blue outline) and the 3DEC model prediction (red areas) for the final open pit design.

ITASCA'S ROLE

For the complexity of the failure mechanism, empirical and limit equilibrium methods were deemed insufficient to perform the back-analysis. Given its good predictive results from 2012, and the three-dimensional nature of the failure mechanism, *3DEC* was again selected to model the open pit for the required back-analysis.

Using the 2012 analysis as the starting point, the analysis was calibrated using field observations, where the geometry of mining excavations and structural interpretation were key inputs. Figure 3 shows a joint system and the projected Steve 4 (S4) and Steve 5 (S5) faults. The calibrated model was used to study excavation alternatives to resume mining of Pushback-12 whilst still meeting the required acceptance criterion (FS > 1.2).

Figure 3. Major faults. Left: interpretation of observed planes from a pit scan on April 27, 2017. Right: 3D surfaces projected by the mine to represent the S4 and S5 faults.



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PROJECT RESULTS

In general, Itasca's *3DEC* modeling of the Steve-event at Bajo de La Alumbrera Mine demonstrates a clear advantage for using numerical modeling tools for slope design to (1) identify potential failure mechanisms and (2) quantify overall slope stability.

The *3DEC* model developed to back-analyze the instability achieved a good match with field observations. Figure 4 shows the calibration results as FS contours for each excavation stage in the 3DEC model. The estimated failed volume in the field was approximately 336,000 m^3. The numerical model estimated a similar volume, 356,000 m^3, based on the failed rock mass shown in red (for FS < 1.0).

In order to continue mining Pushback-12, the *3DEC* modelling showed that a 204-m-high unloading excavation was required in order to maintain the acceptable criterion of the slope design (defined by an FS ≥ 1.2). This alternative was assessed as uneconomic by the mine, leading to the total closure of Pushback-12 and the mine.

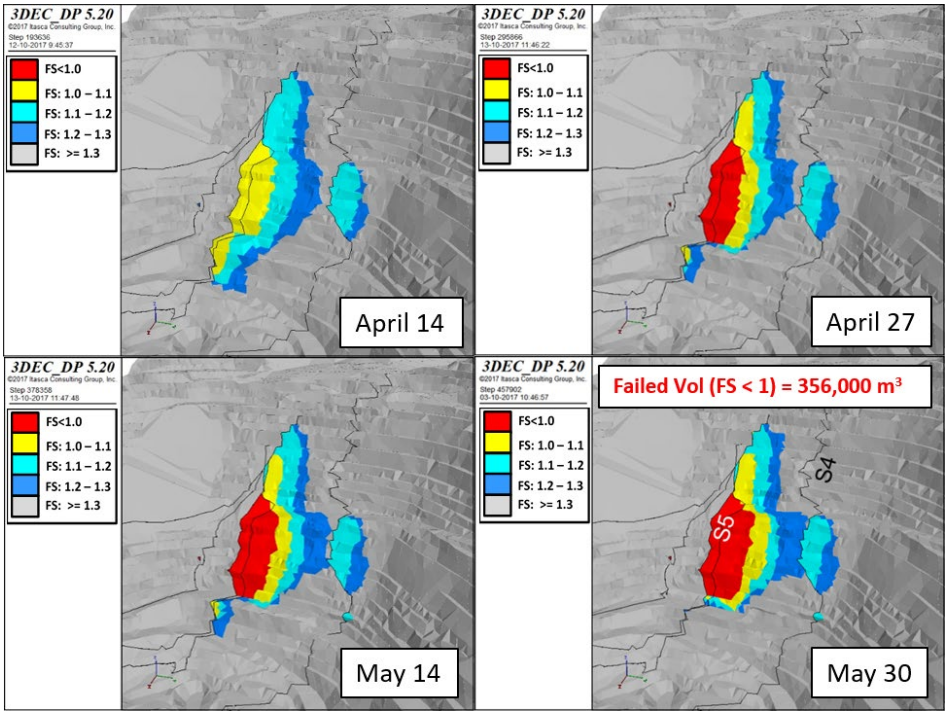

Figure 4. Results in terms of Factor of Safety for the different phases of mining.

REFERENCES

Cancino, CF., Silva, R., Giraud, C. (2021) Numerical assessment of an overall instability at Bajo de la Alumbrera Mine. Australian Centre for Geomechanics, Perth, ISBN 978-0-6450938-1-0. SSIM 2021 - PM Dight (ed.)

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