Cast Blast Modelling

Project Summary

USING MODELLING TO EVALUATE BLASTING OPTIONS

A customer requested assistance in relation to the modelling of cast blasts at one of their coal mines with a view to identifying opportunities to improve the operation. The main objectives were to model several different blasting scenarios and obtain results for predicted muckpile movement and shape.

The process involved entering all the available site information (blast design, pattern dimensions and rock mass properties) into the Hybrid Stress Blasting Model (HSBM) to form the base to be used for each model. This ensured the actual site conditions and practices were accurately represented within the models. This information was used to run models established on a typical base design (design 1) as well as two different designs (designs 2 and 3) that incorporated variable burdens.

Each of the three main design options was modelled in order to ascertain any likely differences in cast values etc. As an extension to this, the same scenarios were modelled with two initiation points (top and bottom) within the columns rather than one. With the results obtained for the three design scenarios with standardised timing, the last step was to use the general parameters of one of the models specifically (design 2) and model some different timing options as well.

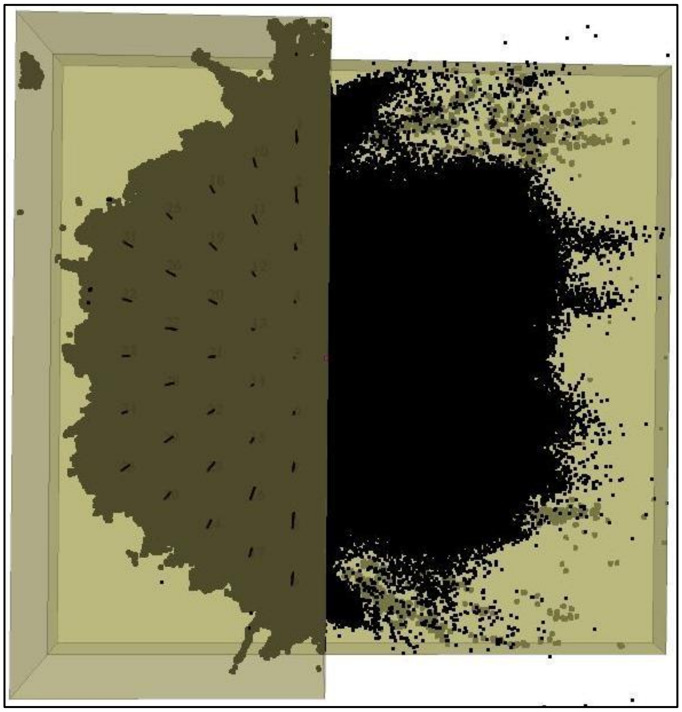
The modelling results indicated improvements in "gain" of around 5% through changes to geometry and initiation sequence. The results of the multiple modelling runs were also used to provide some final general blast design advice for the mine.

Background

A COAL MINE CASTING SHORT BENCHES

This mine operates on relatively short benches (under 30m) with large diameter drills drilling vertical blastholes on patterns of relatively large dimensions. At the mine, three measures of cast are recorded being material past:

1. A 16° plane with a toe position offset 5m from the original toe of coal at the face prior to blasting (GAIN).
2. A 45° plane with a toe position offset 5m from the original toe of coal at the face prior to blasting (CAST).
3. The original position of the free face.



Project Goals

EVALUATING OPTIONS TO IMPROVE CAST

The main objectives were to model several different blasting scenarios and obtain results for predicted muckpile movement and shape. These results were then compared with site measurements in terms of cast percentage and gain percentage. The main outcome of the modelling was to allow a judgment to be formed in relation to the optimum base pattern parameters and timing regimes for site. These base parameters would then be able to be verified in the field and further refined as results were made available.

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Technology Applied

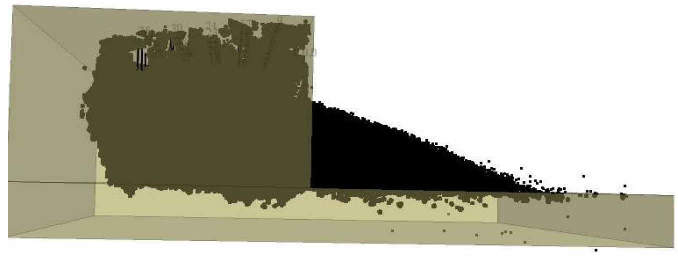
STATE-OF-THE-ART BLAST MODEL EMPLOYED

The Hybrid Stress Blasting Model (HSBM) was used to perform the modelling. The HSBM is a state-of-the-art blasting model that has been developed over many years with an aim to model the complete blasting process and predict results based on known detonation and rock breakage physics (i.e. from first principles). This includes taking into account explosives and rock mass characteristics, blast layout and confinement and the resulting shock, dynamic stresses and gases generated by the explosives. The blast outputs are micro and macro damage (near field), vibrations, fragmentation size distribution, movement and displacement.

Value Added

OPPORTUNITIES TO IMPROVE CAST AND GAIN IDENTIFIED

Modelling of the blasting process is complex. Changes in geology, for example, can have a significant impact on results. In order to minimise this, current site results were used to calibrate some of the model parameters in order to achieve results that are more equivalent to site actual results. As a consequence, the results obtained are much more representative of real world outcomes and can be viewed as providing acceptable "trends" that may be used to guide any planned blast design changes going forward. The following general conclusions were drawn from the modelling that was performed.



A design change to compressed burdens at the front of the blast will *likely* achieve a higher level of cast and gain. The modelling indicates an increase in gain in the order of 2-2.5%.

- A move towards dual initiation of blast holes (initiated at the same time for the lower and upper primer) will *likely* achieve a higher level of cast and gain. The modelling indicates an increase in gain of 1-1.5%.
- The move to flatter timing contours (faster inter hole timing) will *likely* achieve a higher level of cast and gain. The modelling indicates an increase in gain of 2-3%, though this gain may be more variable than the gains achieved by burden or priming changes.

Whilst the "gain" or level of material cast past the theoretical 16 degree low wall was a key driver, the importance of the changes in the models with the other two measures of 45 degree wall and past the face was also considered. The relative change in these numbers is representative of the displacement of the centroid of the material. Whilst only the "gain" numbers refer to material that does not need to be dug or pushed, any additional forward movement in the centroid location represents a benefit for dozer push applications in that the material to be pushed does not need to be pushed as far.

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