Career Episode 1

Numerical Analysis of Primer Location Effect on Uneven Breakage Caused by Blasting

A) Introduction

[CE 1.1]

Title: Numerical Analysis of Primer Location Effect on Uneven Breakage Caused by Blasting

Duration: [Date] – [Date]

Location: Australia

Organization: Curtin University

Position: Mining Engineering Student

B) Background

[CE 1.2]

The most expensive process in the mining world is the drill & blast. The aim was associated with achieving an effective technique for executing blasting. There were chances of providing uneven breakage which cannot be compromised through under or over breakage. There are mining activities that were dependent on the technique mainly relying on longer tenure and there were applications of trial and error technique for minimizing the uneven breakage from altering the dimensions like burden and spacing. Thus, it was an important issue that included sorting the optimized solution.

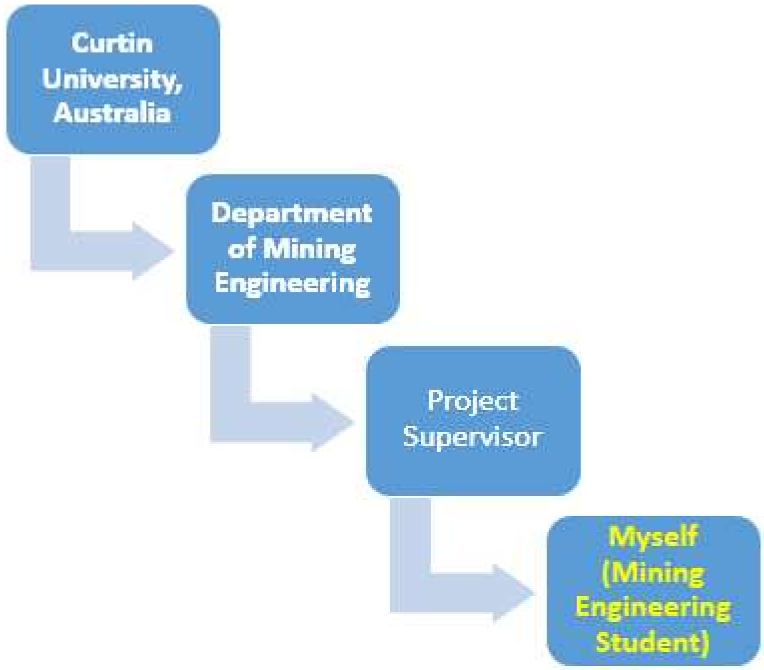
[CE 1.3]

The project aim was researching the primer position alteration which had prominent significance in the uneven breakage formation. Thus, the numerical analysis was done for achieving the primer optimum position and analyzed the resulted factors which included damage, effective plastic strain, and pressure contour.

[CE 1.4]

I conducted the numerical analysis for observing the location of primer which had significance over the uneven breakage. There was positioning evaluated with corresponded results mainly analyzed for reaching to the point where the optimum blasting worked for less uneven breakage.

[CE 1.5]



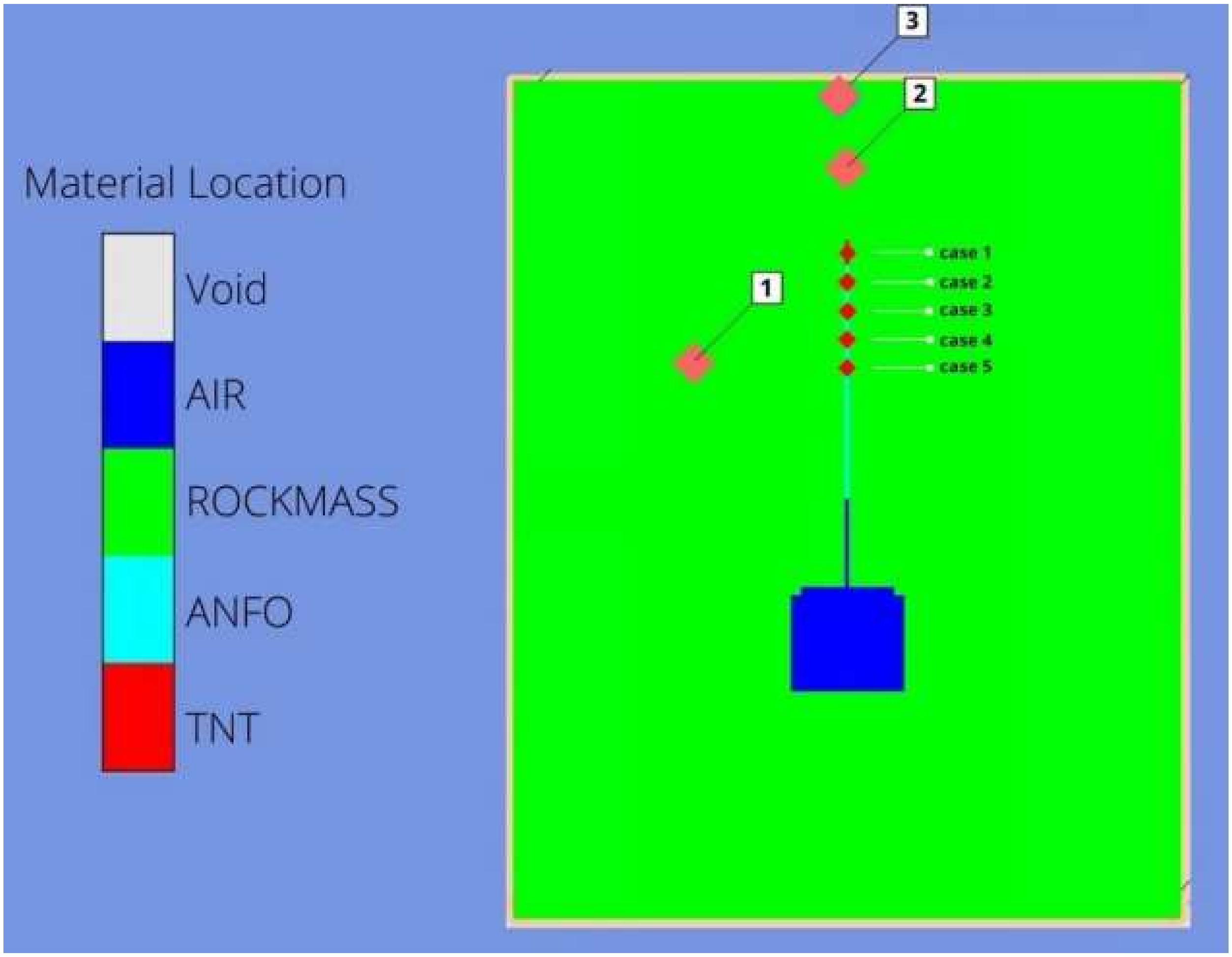
[CE 1.6] Duties:

- I did material model creation for air, explosive-ANFO, primer-TNT, and rock mass.
- I researched with the process analysis which was time-consuming and simulation time accordingly obtained with the 2.9ms.
- I attained the information regarding the damage in the contour format and it made the execution of effective strain with respect to time.
- I worked on setting gauge 3 which was under the sloped boundary and was determined with setting the under or over breakage.

C) Personal Engineering Activity

[CE 1.7]

According to the researched methodology, I created the material models for rock mass, air, explosive-ANFO, and primer-TNT. There was interaction among models to be in software which was linked with the calculated version among the two LaGrange models and Euler models' interaction was accordingly set for automated operation. I researched the numerical analysis process which was a time-consuming process and simulation time was set to about 2.9ms. I obtained the model sample which included showcasing five location cases and these were set to simulation time of about 2.9ms. I obtained the model sample created and showcased all five location cases which were 8m, 8.5m, 9m, and 9.5m. I also researched the sensors which included placement of the sensors in three different locations and these were termed as Gauge 1, Gauge 2, and Gauge 3.

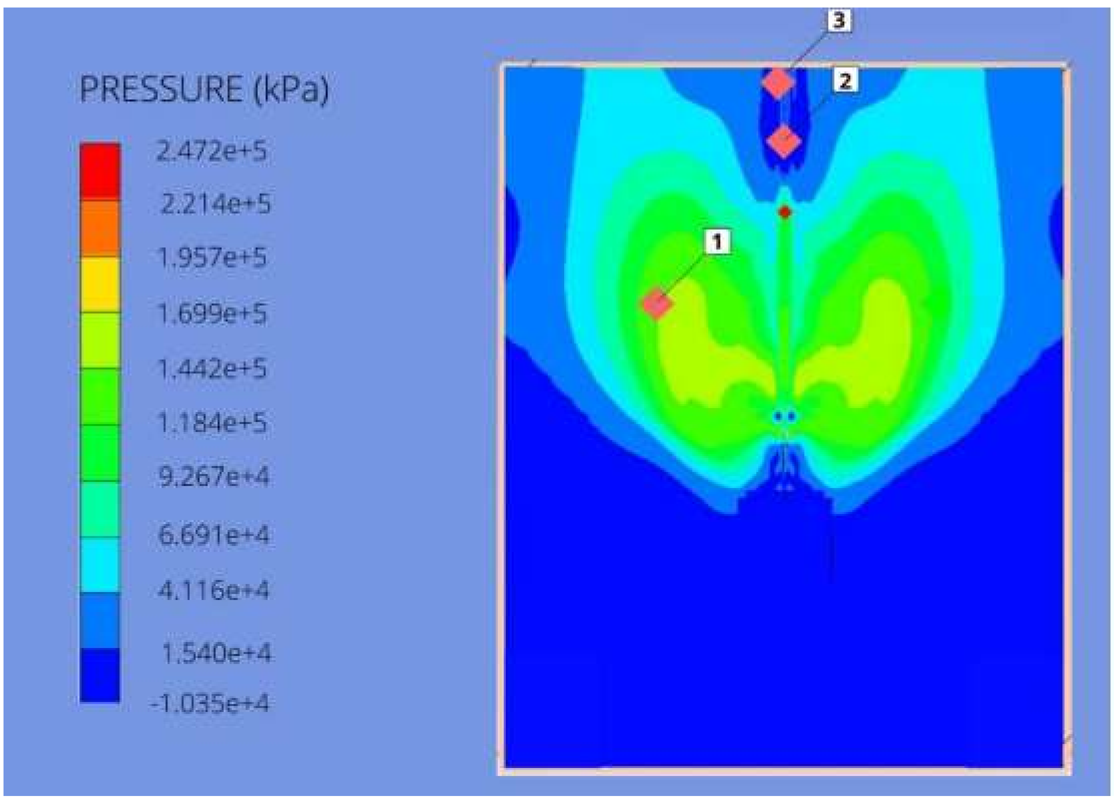


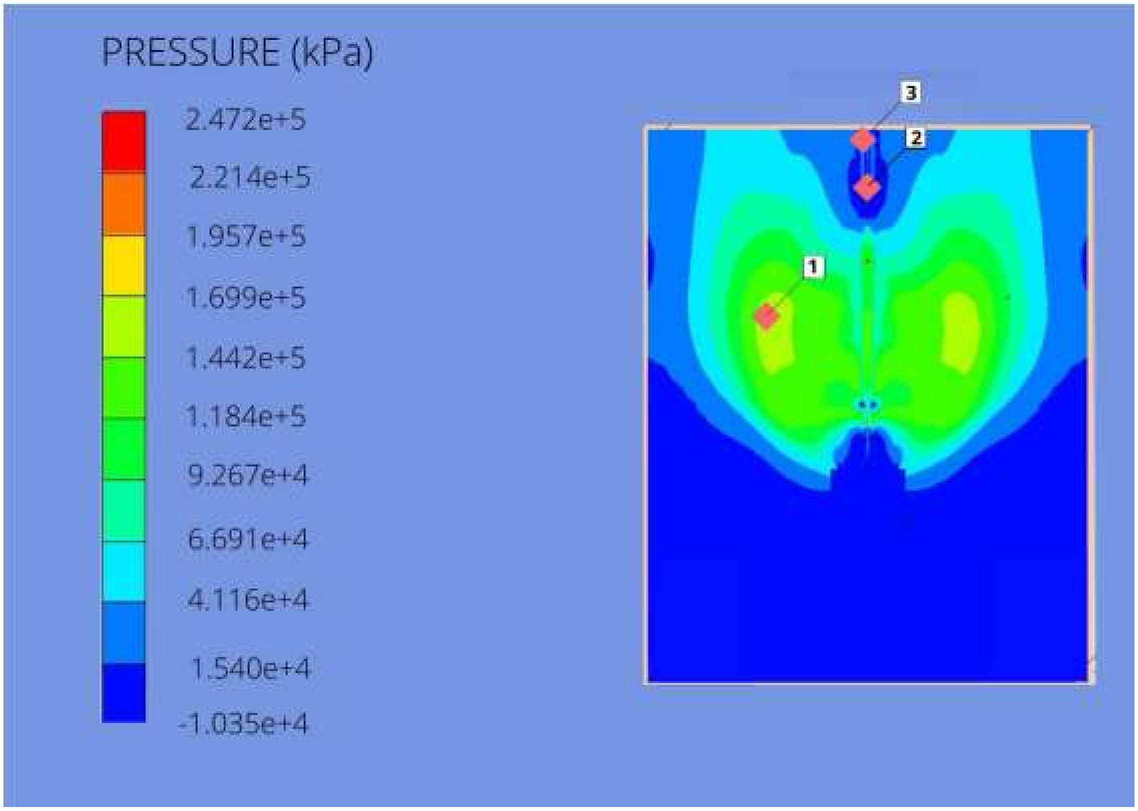
[CE 1.8]

I analyzed the primer optimum location with the least uneven breakage and simulation was executed with 2.9ms and obtained the needed information from each gauge. I conducted an analysis that included information like pressure with respect to time from initial to detonation stage till 2.9ms in the contour format as well as graphical numerical values evaluation. Moreover, I obtained information related to the damage in the contour format and it included effective strain with time respect mainly obtained in graphical numerical values. These were utilized for further analysis. The pressure originated in the rock mass from blasting was compared with the rock mass compressive strength. I obtained the compressive strength of Pennsylvania Blue Sandstone which was 3.5 x 104 kPa and the accumulated pressure in the rock mass because of the blasting and it caused the rock mass breakage. I set the gauge 3 which was placed in the sloped boundary and the pressure in the Gauge 3 was determined whether it was under or over breakage. When the pressure gauge 3 exceeded the compressive strength, there was over breakage and the pressure in gauge 3 was lower than the compressive strength. It led towards under breakage and the pressure location also exceeded the compressive strength with the least uneven breakage. Thus, the pressure location also exceeded the compressive strength which was at the effective strain information at 2.9ms in Gauge 2. There was Pennsylvania Blue Sandstone which had minimum strain to failure at about 0.01. At gauge 2, there was effective strain exceeding the parameter to set the most fragmentation case.

[CE 1.9]

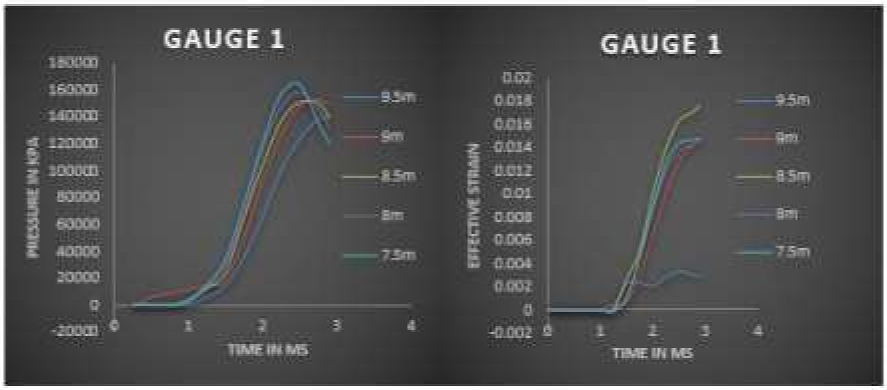
I executed the contour maps which indicated the pressure and damage at 2.9ms which was obtained from ANSYS AUTODYN and numerical values were achieved for pressure and strain with respect to time. I evaluated the contour for pressure at 2.9ms for different cases. There was the damage contour obtained at 2.9ms.

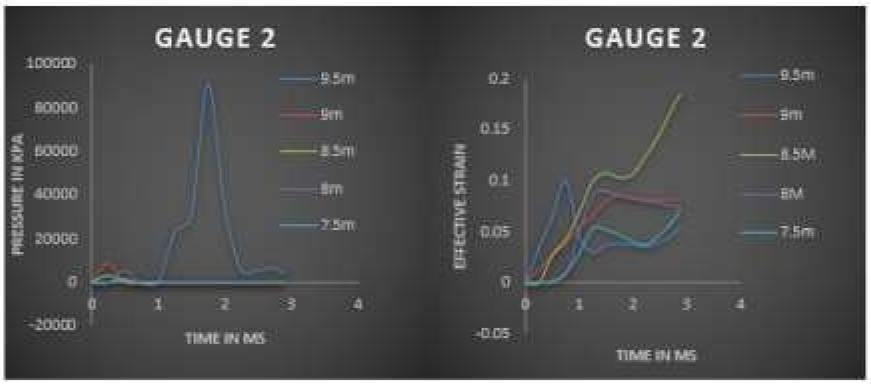


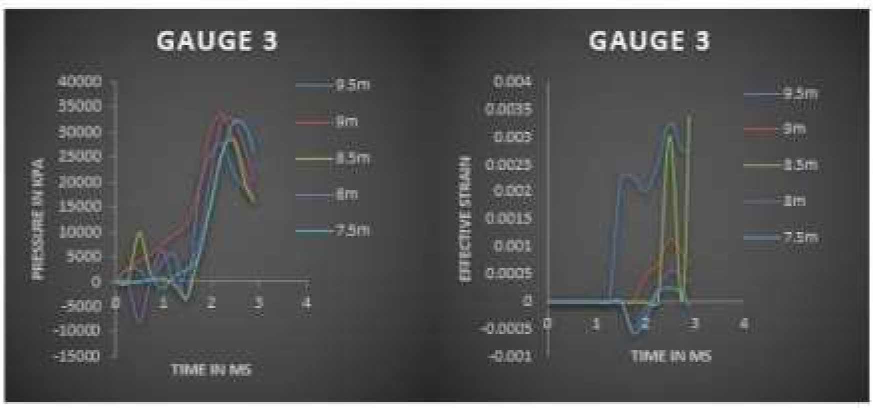


[CE 1.10]

I researched the brittle materials' mechanical behavior with the static and dynamic loading condition consideration which made the failure model created utilizing the Riedel-Hermier-Thoma model more comparable with the defined aspects. I obtained the explosive ANFO energy distribution with the primer TNT which was achieved from the JWL's Equation of State usage. There was a detonation mechanism with material properties while a highly expanding nature was governed under the set JWL equation. I conducted the graphical information analysis on the pressure with respect to time and the effective strain was analyzed as well with respect to time. There was numerical analysis carried out utilizing the set information.







[CE 1.11]

I analyzed the graphical information and obtained information which was for case 1, 2 & 3 pressure originated was about 2.8 x 104 kPa, 3.5 x 104 kPa & 3.4 x 104 kPa. It was less than the set compressive strength of rock mass and it led under the breakage which included stope consideration depending on rock mass strength. With the increment in pressure, it resulted in leading towards the breakage and the stope considered as well as waste around it was fragmented. There was the least uneven breakage which was the primer's location at 8m and consideration made of the fragmentation of each case. Some cases exceeded with the effective strain needed for the rock mass failure which was 0.01 and the fragmentation that occurred was set at 8.5m.

[CE 1.12]

I conducted thorough research with the evaluation made of various factors and each work activity was evaluated with the implementation of the technical Marine Engineering skills particularly resulted in gaining the mandatory project results.

D) Summary

[CE 1.13]

I evaluated and conducted a trial and error technique which was the practical way of blasting as there was mining with no space for experiments as it led towards great capital loss. Thus, I conducted a numerical analysis which provided a benefit over the testing. From the numerical analysis, I set the primer location with optimum uneven breakage as 8m. According to the research, there was blasting which was the most expensive process in the mining industry. I minimized the negative impacts which affected the mining as it was the main objective.

[CE 1.14]

There was uneven breakage which led towards enhancing the mining cost from secondary blasting application and it was minimized accordingly. There was practical experimentation on the same scenario which was made for proving the statement and this was not a trial and error application was there was numerical analysis mainly worked on proving the correct intentions.

[CE 1.15]

I researched each aspect by carrying out thorough research and applied fundamental technical skills in the Mining Engineering field. All the set outcomes were achieved within the defined timeline.