Brown Coal Structural Geological Mapping with I-Site

Ben Pang
Jasveen Sidhu
Wouter Hartman

Latrobe Valley Geotechnical Group Meeting
8th April 2014
Outline

• Introduction
• Project Background
• MAPTEK I-Site Scanning & Data Processing
• 3D & 2D Structural Geology Model
• Correlation with Historical Joint Data
• Limitation of I-Site Mapping
• Practical Use in Mine Planning
• Acknowledgements
INTRODUCTION

Geohart Consultants was engaged by GDF Suez Hazelwood to develop:

- A ground control management plan (GCMP) since 2013.
- A structural geological model of the mine as part of the GCMP was required.
INTRODUCTION

Historic failures highlighting the importance of structural geological models for mine designs at Hazelwood; other Brown Coal Operations and other open pit mines:
Stability of the coal operating faces at Hazelwood mine has been assessed every five years since 1974.

Direct scan line mapping of coal batters was not feasible in Hazelwood coal mine because of the enforcement of a mandatory safety stand-off distances at the toes of the coal batters and the inaccessibility due to the toe drains.
Therefore, MAPTEK I-Site scanning was chosen as a reliable and safe method of structural mapping.
MAPTEK I-SITE SCANNING & DATA PROCESSING

MAPTEK I-site scanning suite has two components; the scanner and a controller.
MAPTEK I-SITE SCANNING & DATA PROCESSING

- The batters that were scanned using 8810 scanner.
MAPTEK I-SITE SCANNING & DATA PROCESSING

- I-Site scanner scans the coal batters and save the scans in the form of 3D point clouds.
- 3D point cloud data is converted to 3D surface with the help of I-Site Studio software package.
MAPTEK I-SITE SCANNING & DATA PROCESSING

- 3D surface is then overlain by the photo taken by the in-built camera of the scanner.
MAPTEK I-SITE SCANNING & DATA PROCESSING

- Extraction of joints

Joints are to be extracted
MAPTEK I-SITE SCANNING & DATA PROCESSING

- Geotechnical module of I-Site studio enables to extract and measured all the joints captured in the scan.
Orientation of the mapped joints is presented in the form of strike/dip direction and can be exported in the form of text files.
LIMITATIONS OF I-SITE MAPPING

I-Site scanning cannot be progressed in foggy, rainy and dusty weather conditions.
LIMITATIONS OF I-SITE MAPPING

Joints with no exposed surface cannot be mapped.
LIMITATIONS OF I-SITE MAPPING

Joints located at a sharp angle relative to the scanners’ position cannot be captured.
LIMITATIONS OF I-SITE MAPPING

Scanning done during the unfavourable sun-light hours will lead to poor photo quality.
CORRELATION WITH MANUALLY MAPPED JOINTS

- For the purpose of quality control, a few checks are normally made where manually mapped joints are compared against the joints mapped by I-Site.

- No comparison has been drawn yet with other similar technologies such as Sirovision and TopCon.
3D & 2D STRUCTURAL GEOLOGY MODEL

- 3D Structural Geological Modelling
3D & 2D STRUCTURAL GEOLOGY MODEL

- 3D Structural Geological Model
3D & 2D STRUCTURAL GEOLOGY MODEL

- 2D Structural Geology Model
  Thematic Map of Joint Data
For carrying out kinematic analysis, joint data was categorised into different joint sets.
KINEMATIC ANALYSIS

- Three major joints identified across the mine were:
  - J1 (Sub-vertical set)
  - J2 (Steeply dipping set)
  - J3 (Low angle set)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>84/053</td>
<td>J1</td>
<td>85/047</td>
<td>J1</td>
<td>86/061</td>
<td>Sub-vertical set</td>
</tr>
<tr>
<td>J1a</td>
<td>87/245</td>
<td>J1b</td>
<td>79/249</td>
<td>J2</td>
<td>87/242</td>
<td>Sub vertical set</td>
</tr>
<tr>
<td>J1b</td>
<td>85/069</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Sub vertical set</td>
</tr>
<tr>
<td>J2</td>
<td>76/089</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Steeply dipping joint set</td>
</tr>
<tr>
<td>J2a</td>
<td>67/051</td>
<td>J1a</td>
<td>54/033</td>
<td>-</td>
<td>-</td>
<td>Steeply dipping joint set</td>
</tr>
<tr>
<td>J3</td>
<td>38/052</td>
<td>J3</td>
<td>18/049</td>
<td>J3</td>
<td>44/66</td>
<td>Low angle set</td>
</tr>
<tr>
<td>J3a</td>
<td>45/084</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Low angle set</td>
</tr>
</tbody>
</table>
DIPS and Swedge software packages were used to analyse all the major joints set and their sub-sets for the following modes of failure:

- Plane Failure
- Toppling
- Wedge Failure
PRACTICAL USE IN MINE PLANNING

- By processing the I-Site data, the spatial distribution of inferred rock joints behind the slope face can be visualised and is useful for deducing the rock mass structural condition.
- For Hazelwood’s case the surface drain design can now be suitably improved.
ACKNOWLEDGEMENTS

- We would like to thank the management of GDF Suez Hazelwood, in granting permission to present the I-Site mapping data and the associated information.