Safer survey of alignment in underground mining

by Erich Tetema, Petra Diamonds and Coenie van der Bergh, Aciel Geomatics

Keywords

- Control point – a survey point that has a 5 mm accurate $yx$ and height value.
- Orientation – positioning the instrument on the known grid using horizontal angles.
- Roll bolt – wall mounted steel bolt that can be fitted and tightened.
- Plumb bob – string line with a pointed weight.
- Reflectormless – distance measurement that requires no reflector
- Grade – the zero design of the mine
- Chain – metal chain that is cut to a specific length for each control point

Introduction

Underground mine surveying are projects where the surveyor is required firstly, to produce profile points and markings to assist the miners in drilling and blasting, and also for the monitoring of certain problem areas and finally, to supply data to calculate volumes that will be used for progress reports and planning.

We will explain how a tunneling application, which is currently used by Finch Mine, is a safer and more practical alternative for the setting out of alignment points.

Characteristics of underground mining surveys

- Underground control: The control consist of points previously surveyed, these points are placed in the hang wall of the mine. The surveyors need special equipment to place and survey these points. They need to use a ladder of 6 m long with all the safety gear, special roll bolt pegs and prisms.
- Instrument setup: The instrument needed to be set up under a hang wall control point. To do this a plumb bob needs to be fitted to the control point by using the ladder and then measuring the height of the instrument.
- Orientation of instruments setup: At least two orientation control points need to be surveyed, again using the ladder and prism.
- New control points: New control points can be placed and surveyed by firstly, placing the point with the ladder, then drilling the holes, fitting the roll bolt pegs and finally, observing the prism on the point.
- Grade lines: New chains are cut to grade lengths for the new control points for use by the miners.
- Survey of new mined volume: A survey of the mined area can now be done by using a pole with a prism or by using reflectorless for readings on set intervals and positions on the mined area.

Characteristics of underground mining surveys using the tunnelling application

- Underground control: Control consists of points previously surveyed, these points are placed at a specific chain age and on grade in the side wall on both sides of the mine by using the stake option of the tunnel application. The surveyor needs to use the special roll bolt pegs and observe them with a prism or reflectorless.
- Instrument setup: The instrument can be setup on any place in the mine where the surveyor can observe two (2) or more control points (side wall pegs).
- Orientation of instruments setup: At least two orientation control points needed to be surveyed using the prism or reflectorless.
- New control points: New control points can now be placed by the drilling of holes in the side walls on both sides of the mine, and fitting the roll bolt pegs. Then observing the pegs with a prism or reflectorless. These points can be placed at a specific chain age and on grade by using the stake option of the tunnel application.
- Grade lines: New cables are cut to fit between side wall pegs and the centre line is marked for use by the miners.
- Survey of new mined volume: A survey of the mined area can now be automatically done on set intervals and positions by using the scanning option of the mining application and the reflectorless readings.

Benefits of using the tunnelling application

- Underground control: More control points can now be placed at a specific chain age, grade and position in the side wall of the mine. No ladder with safety equipment is needed.
- Instrument setup: The instrument can be setup on a convenient and safe place to do the survey. No plumb bob and ladder with safety equipment is needed.
• **Orientation of instruments setup:** Orientation can be done to more than three orientation control points for better accuracy. The prism or reflectorless distance measurement can be used. No ladder with safety equipment is needed.

• **New control points:** Points can be placed and surveyed at a specific chain age, grade and position. These side wall pegs can be placed and fitted without using a ladder and safety gear. These pegs can be surveyed by using the reflectorless distance measurement.

• **Grade lines:** Because no ladder and safety gear is needed more grade points can be placed to help with control. This also assists with accuracy for the miners.

• **Survey of new mined volume:** The volume survey of the mined area can now be automatically done on a set interval and position and by using the reflectorless distance measurement.

• **Cut and fill:** This information (over and under break) is displayed as the survey is being automatically done. A report sheet can be generated during the volume survey with the cut and fill information off each point that is surveyed.

**Acknowledgements**

Leica Geosystems AG, Heerbrugg, (Switzerland), [www.leica-geosystems.com](http://www.leica-geosystems.com)

Petra Diamonds, Finsch Mine, (South Africa), [www.petradiamonds.com](http://www.petradiamonds.com)

Aciel Geomatics, Midrand, (South Africa), [www.aciel-geomatics.co.za](http://www.aciel-geomatics.co.za)

Contact Erich Tetema, Petra Diamonds Finch mine, Tel 053 385-2583, ericht@petradiamonds.com and Coenie van der Bergh, Aciel Geomatics, Tel 082 619-4118, coenie@aciel-geomatics.com