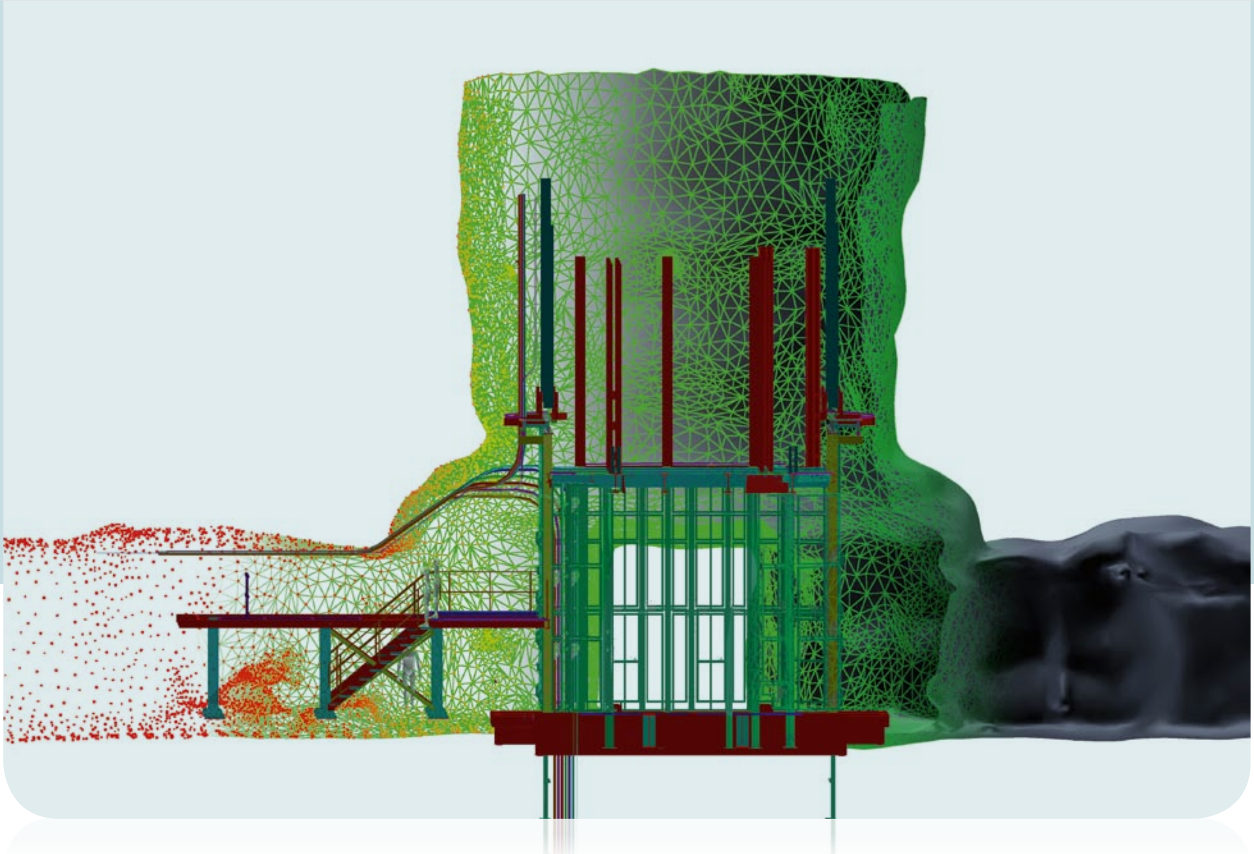

Modeling the World's Deepest Mine

by Rekha Voralia and James Jobling Purser

Owned by Anglo Gold Ashanti and employing 6,000 people, Mponeng Mine is part of the old Western Deep Levels Complex, near Johannesburg, South Africa and, as of last year, is officially classified by The Guinness Book of Records as the world's deepest mine. At its deepest point the mine extends to a depth of 4.1 km (2.5 mi) below surface, where the rock temperatures can reach 60 °C (140 °F) and the ambient temperature reaches 36 °C (97 °F). To highlight potential problem areas before the installation of a new conveyor, a monorail, and a chair-lift at the mine a survey was carried out to build an accurate as-built 3D model of the development.

Using the 3D CAD model of the declines the relevant service infrastructure could be overlaid in a virtual CAD environment to determine any areas that needed modifying before construction and installation commenced. Small deviations from the original design could potentially cause problems during installation, so creating a 3D model was critical in preventing delays and costly overruns.

Creating a 3D CAD Model

The scope of the job was to survey 3 km of development declines which had been identified as deviating from the original design and could affect the installation. The project has four parallel declines that have been developed at an inclination of -7.5°, progressing from levels 120 to 123 and 126. Underground mine surveying specialists 3D MSI were commissioned with three objectives: Firstly, to survey three of the four declines in 3D; secondly, to use the 3D CAD model to identify potential problem areas; and finally, to superimpose the geo-referenced CAD models of the services to aid in the identification of these problem areas.

A Challenging Working Environment

Work in the mining industry is highly challenging, surveyors not only have to put up with working in confined conditions but they also have to cope with a constant flow of traffic dirt and extreme heat. Any delays in mining activity can result in hundreds and thousands of pounds in lost income so 3D MSI *(www.3dmsi.co.uk)* were under immense pressure to ensure their work was conducted with speed and minimal disruption to the daily work of the mine. Their business depends on reliable, fast, and accurate technology and working with Leica Geosystems is fundamental to the success of 3D MSI.

The speed and accuracy of this technology can save mining companies hundreds of thousands of pounds per contract.

Based in the United Kingdom, 3D Mine Surveying International Limited (3D MSI) specialize in underground mine surveying and 3D modeling of survey data. From site works to data processing and creating complex 3D drawings, 3D MSI use the latest laser scanning instrumentation and a specially designed remote surveying vehicle (RSV) to survey underground operations at high speed. Working closely with mine surveyors, design engineers, and health and safety auditors, the resulting data is used to ensure mine operations become safer and more efficient with modern surveying technology.

To conduct the survey 3D MSI used the Leica ScanStation C10, Leica HDS6000, and the Leica HDS6100 High Definition Surveying™ laser scanners. Software used included Leica Cyclone for collecting and processing point cloud data and 3D Reshaper for modeling. Owing to difficulties with the fine tolerances between the extent of the infrastructure and the tunnel design, 3D MSI surveyed down to - 3,900 m (2.42 mi) to provide a comprehensive analysis of problem areas prior to the installations. A total of 240 separate scans were taken for all 3 of the declines, equating to a combined distance of 3.5 km (2.2 mi).

Comparison to Original Design

A complete wireframe was constructed for each decline using 3D Reshaper; this allowed a comparison to be made between the original design and the model of the actual development. Once the wireframe had been created it was possible to combine the 3D design with the CAD models of the equipment being fitted into the declines to ascertain whether they were going to fit as designed.

One of the most obvious discrepancies observed was at the top of decline 2. If the conveyor had been installed as originally designed, it would have penetrated the sidewall 1.2 km (0.7 mi) further down the decline. By superimposing the conveyor into the decline in the CAD environment it was possible to adjust the conveyor's position in a virtual setting to determine if there was a solution to the problem without having to undertake costly engineering work. By doing this it became apparent that if the conveyor were moved 0.5m to the left it could fit without the need for any modifications to the tunnel profile.

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