Survey solution for underground

Maptek™ I-Site™ laser scanning handled a large underground survey project with ease, delivering timely, accurate data to guide limestone mining operations.

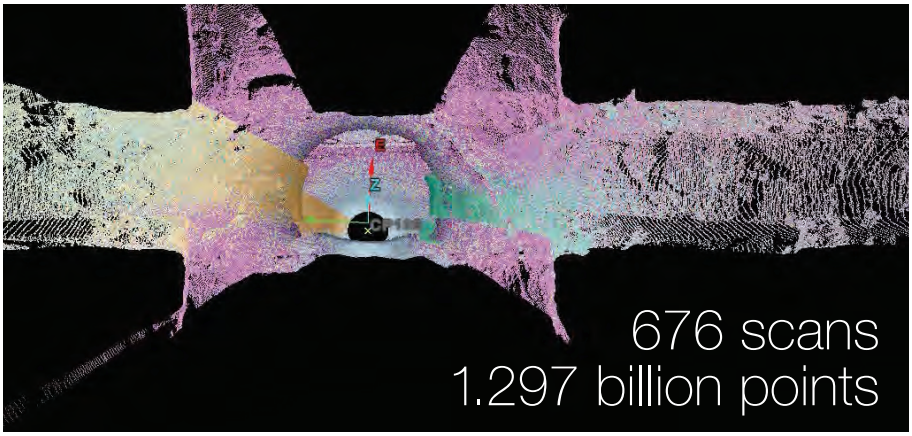
In late 2014, the extensive northern underground workings of the Lafarge Conco limestone mine near North Aurora, Illinois, were surveyed using the Maptek™ I-Site™ laser scanner.

'Our main objective was to complete old mine maps of historical workings and to catch up to current production' explained Talia Flagan, Quarry Manager of the Paulding Cement sector of Lafarge.

Limited staff on site meant there was not always time to survey the pillars. Lafarge needed a map of the existing underground workings with accurate pillar locations. They wanted to ensure that the mine design was being followed, and also that the pillars were not being undermined from the level below.

Lafarge determined that, due to the extent of the workings a traditional survey would take more than three months and also be very costly.

Laser scans registered together with pillar locations



Traditional methods would have been adequate for the as-built needs but timing and cost were major factors leading to the choice of laser scanning.

'Maptek was highly recommended by our geotechnical consultant. The I-Site system is a leader in this field, and competitive pricing enabled us to move ahead with the project,' added Flagan.

It took about 30 minutes to travel into the mine and set up the equipment. Setups were on average 90 feet apart and a low resolution 360° scan was completed in 3 to 4 minutes.

The I-Site 8200 laser scanner was ideally suited to the underground survey task. The 125° scanning aperture ensures good overhead coverage. It has a tilt compensator and integrated compass.

With more than 600 scan locations, it was a big survey job, requiring 10 days of scanning across 10-12 hours a day.

Data can be collected at up to 500 metres, with multiple point density settings for different purposes. The minimum range of 1 metre allowed scanning of the tops of the pillars on the double benched areas; this provided important data for later model creation.

The biggest advantage of the I-Site 8200 is the ability to attach it to various industrial vehicles. At the Conco operation it was mounted on a Bobcat 3400XL.

Conco Mine has a single access portal for vehicles. Tunnels ranged from 100 feet to 2,100 feet. Single bench height is approximately 25 feet and double benches 50 feet. Active mining was underway during the project. Maptek coordinated with other equipment operators to ensure production was not impeded and staff remained safe.

Surveying was undertaken from all accessible and safe drift intersections of the northern mine extent. Of the scan locations, 435 were at Conco North Mine Level 1, and 211 at Level 2.

Getting started

Tripod mounted setups at 13 surveyed scan points allowed the I-Site instrument height to be measured, with internal compass readings used to determine the azimuth of the laser scanner.

Additional scans at higher resolution from these survey-controlled locations provided extra detail. A total of 30 high resolution 360° scans completed the setup phase.

The I-Site 8200 laser scanner was then transported on the bobcat to conduct stop-go scanning at lower resolution at drift intersections. Each of these lower resolution scans averaged 2 million points, collecting about 1.3 billion raw points of data overall.

Using Maptek I-Site Studio 5.0 software, all the point cloud data was registered to the survey data, creating a single 3D point cloud containing millions of individual x, y, z points. Scans were easily registered to one another using global registration.

A triangulated 3D surface was then generated from the registered point clouds for the 30 higher resolution and 646 lower resolution scans.

After surfaces were created for each of the two levels, mid-rib contours were created at the requested elevations of 340 feet for Level 2 and 416 feet for Level 1. The mid-rib line represented the as-built, showing areas that had been mined.

Accurate results

Once all the scans for both levels were registered, surfaces were created and exported as .dwg and .dxf files. Mid-rib contours were created, and polylines also exported in .dwg and .dxf format for use in the site CAD software.

Other deliverables included scan coordinate locations in .txt and .csv formats, and 3D PDFs for viewing Levels 1 and 2. Field notes recorded on level maps during scanning were supplied with corresponding intersection names.

Lafarge now has a comprehensive 3D map of its underground workings for planning, operations and any closure studies.

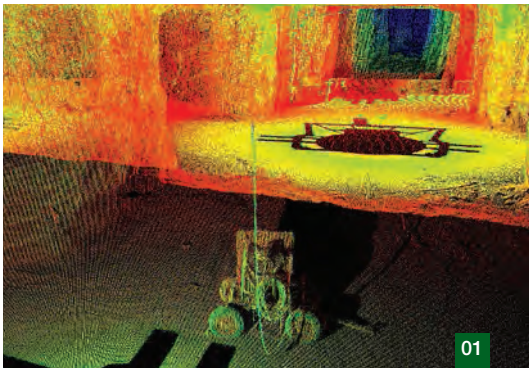
The collected 3D scan data can be used in future evaluations without the need to re-survey.

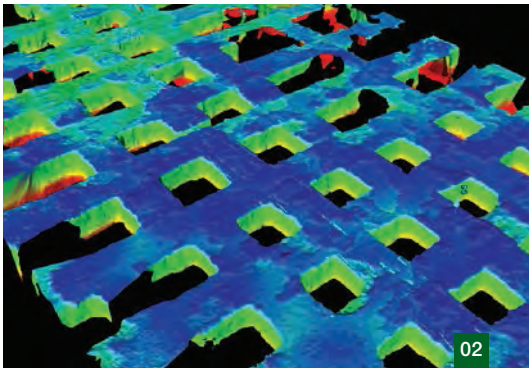
The data collection phase of 10 days plus a further 2-3 weeks processing the massive point clouds, was a significant reduction on the 3 months estimated for conventional survey.

Screen captures showing dominant trending structural orientations as strike and dip provide excellent detail for conducting geotechnical analysis of large structures, faults and bedding planes. Further geotechnical analysis could help to determine structural density, bedding orientations and major trends for the aggregate operation.

Looking to the future, Lafarge is considering using the laser scanning approach for mapping all sill thicknesses, Level 3 of the mine, and geological features. Data will be used for stability studies for site safety, as well as for assessing changes if equipment is modified or replaced.

Thanks to Lafarge, Conco Mine





01 Laser scanning setup at drift intersections
02 Modelled surfaces coloured by intensity
03 I-Site 8200 laser scanner mounted on bobcat