

# Laser Scanning of Shotcrete Thickness

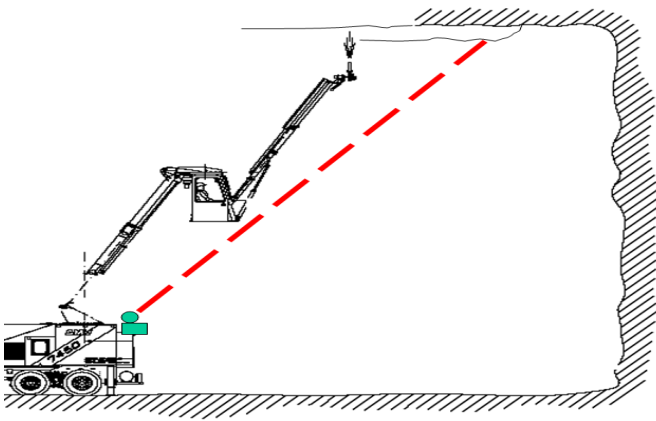
## CASE STUDY - LKAB Kiruna, Sweden:

### Reducing shotcrete costs by determining accurate average thickness

In Scandinavia, shotcrete is normally used as final lining for permanent rock support in tunnelling. Shotcrete thickness is a critical parameter for the success of the process.

Bever Control has developed a laser scanning system that can be operated by the operator from a mobile vehicle like a drill rig or shotcrete robot. The system is robust and well suited for the environment in tunnel construction.

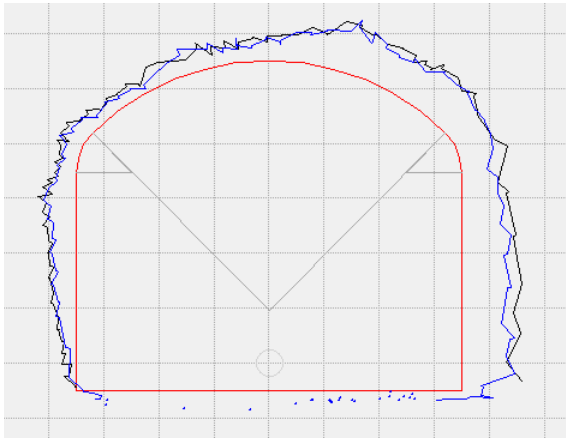
Scanning results are presented in a topographic map of the tunnel surface. The system gives the operator measurement results during spraying, as well as it will be possible to present a documentation of thickness over each blast or setup of the shotcrete operation.



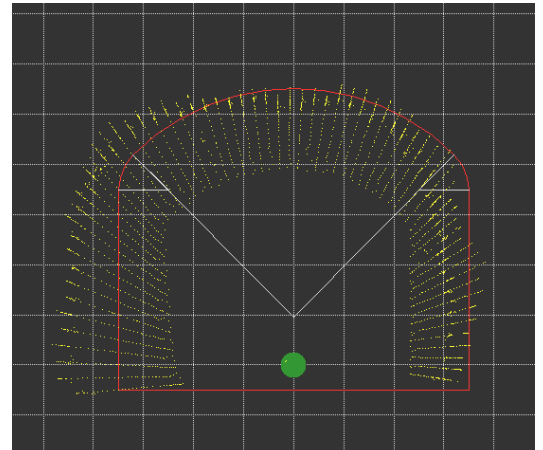
Movements during shotcrete spraying is monitored and corrections are applied if needed. The system is handled by the shotcrete robot operator.



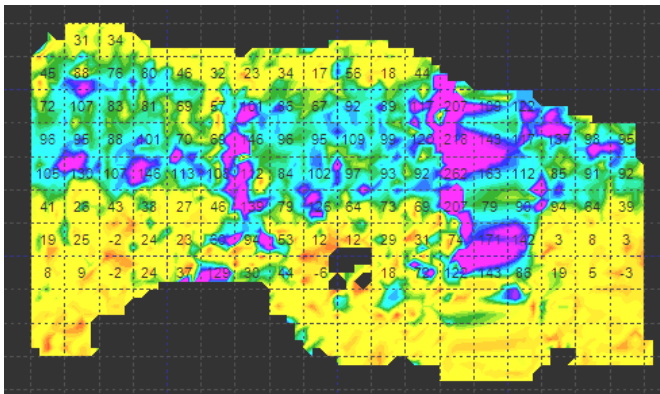
Placement of Bever 3D Profiler, automatic docking under a protective hood for easy cleaning



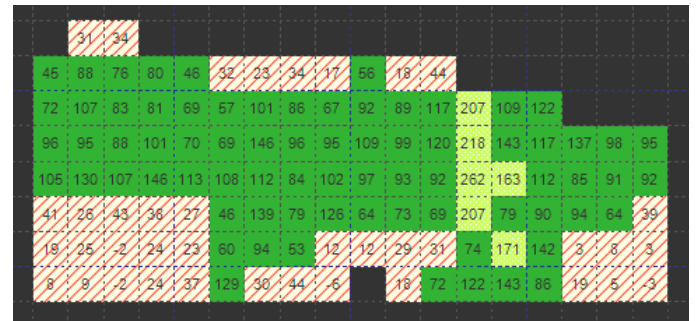
A typical 2D cut of contour lines before and after shotcrete spraying.



Graphical representation of all single measurement points in a scan.



Surface plot showing thickness of applied shotcrete. Yellow colour is around 0 cm and purple 20 cm or more.



2D plot showing graphically the sprayed result divided in three classes of thickness:

Red: Insufficient

Green: Sufficient

Green stripes: More than sufficient

Thickness is measured with better than 10 mm accuracy as average per  $m^2$ . This is proven with extensive drill tests. LKAB Berg & Betong has reported more than 20 % savings on concrete volume, due to more accurate thickness control and operator training.

In one year, the concrete volume was reduced from  $2,8 m^3$  to  $2,2 m^3$  per tunnel meter. Reduction was possible due to good knowledge of thickness distributions, and has lead to significant savings.