CASE STUDY

Double Layer Blind Blast (DLBB) – WebGen™

Agnico Eagle Kittilä mine, Finland

Site Profile

Agnico Eagle Kittilä mine in Northern Finland is an underground narrow vein gold mine with an annual production of two million tons of ore. Kittilä mine has adopted Orica's wireless electronic blasting system, WebGen™, as part of their transverse and longitudinal long hole stoping methods. WebGen™ primers are used as an alternative to traditional electronic blasting systems.

The Situation

Sublevel stoping in narrow sub-vertical ore body with stope heights of 25 to 40 meters requires significant meters of lateral tunnel development. At Kittilä, the annual development rate is around 17 km.

The pinch and swell-type orebody continues downwards in several lenses, which partly disappear creating areas which are not economical to mine out. Access and production headings development needs to be balanced and is calculated for each stope evaluating if development and production costs can be covered by the production of ore.

In areas, where the orebody does not continue in upward direction, the value of produced ore needs to cover the total upper level (drill level) costs and half of the lower level (loading level) costs. Alternatively, the upper level is not developed and uphole stopes are used from the lower level.

In narrow uphole stopes the maximum stope height is strongly restricted by rock properties. Longitudinal stopes with heights over 15m tend to have freezing problems in the uppermost part of the blast and will not reliable drop down when blasting.

In transverse stopes the production headings do not have enough void and additional width needs to be blasted before the actual stope can be drilled and blasted. This includes also secondary ground support work to be done to ensure safe working conditions for the drill and blast crews. Drilling, charging, and blasting in two steps, the extra ground support needed is time consuming and increases the total mining cycle time of the stopes. This in turn effects the mining of secondary stopes/ parallel ore lenses as the stope back fill (paste fill) needs to be properly dried.

Technical Solutions

The development of a wireless initiation system has created new possibilities to re-think conventional mining methods. Until now, blast designs have been limited by lead wires of conventional initiation systems that are needed to transfer signals to detonators.

With Orica's wireless WebGen™ initiation system, several benefits can be achieved:

- Improved mine lay-out due to improved ore production per development meter.
- Increase stope height with longitudinal stopes as the upper section and lower section of the blast can simultaneously be drilled and charged (on top of each other).
- Improved rotation of transverse stopes can be achieved with less production cycles.
- Rock mechanical unstable stopes, which cannot be re-entered after the first blast can be pre-charged at once and blasted in several pre-defined sections.
- Stopes in risk areas, nearby stopes with low quality paste fill, can be pre-charged and blasted without returning of crew.

The Result

Double layer blind up hole stope design, longitudinal stopes

Orica has the capability to charge upholes of more than 35 meter length. As the levels are 25 meter in height, the limiting design factor for the developed Double Layer Blind Blast (DLBB) up hole stopes is sufficient void and maximum blasted height which will cave down. All the tested stopes had an ore block with a smaller height than the maximum stope height (5m tunnel + 15m lower part + 15m upper part).

CASE STUDY

Double Layer Blind Blast (DLBB) – WebGen™

Agnico Eagle Kittilä mine, Finland

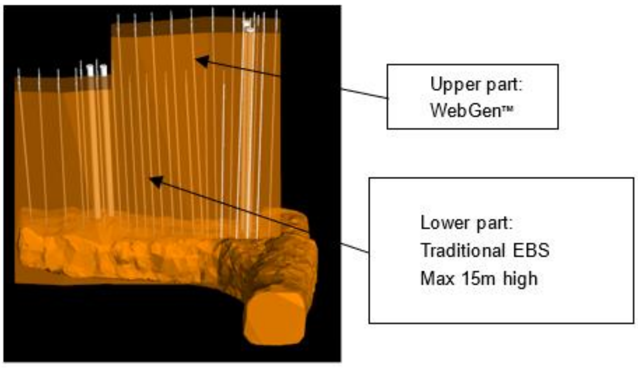

Figure 1. Drill design and block model for 27m high longitudinal double layer blind up hole stope.

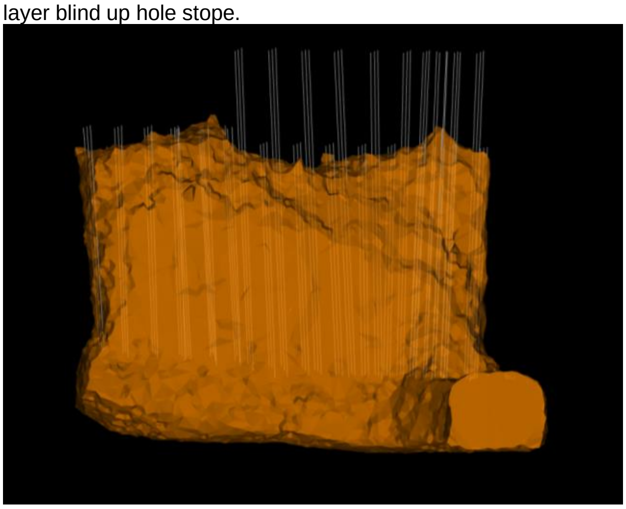

Figure 2. Blast results after 15m high lower part.

To minimize dynamic shock effects and assure that the WebGen™ detonators in the upper blast part would survive unharmed (shrink wrapping) during blasting of the lower blast part, different blast holes were drilled for the lower and upper blast parts.

In the case of upper blast part (figure 1 & 2), a 15meter collar length was used. To ensure emulsion retention in each hole, when the lower part is blasted, Subtek™ Velcro emulsion with a high viscosity and blast plugs were used.

A single hole initiation was used as timing design. Delay was 100ms between holes (3 holes in the row) and 300ms between rows. Initiation of the WebGen™ primers was verified by using an accelerometer installed close to the stope. No problems have been encountered during the blast.

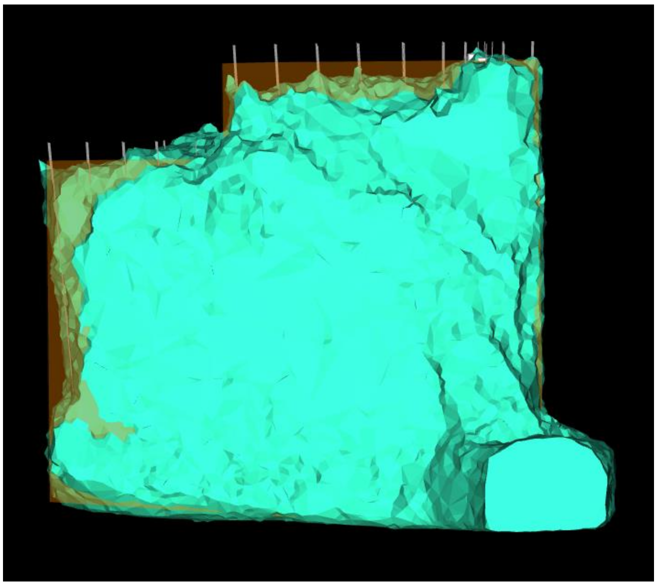

Figure 3. Blast results after second part.

Double layer blind up hole stope design, transverse stopes

The transverse stope design has no need for drilling double holes like the longitudinal stope design. The maximum stope height is determined by the void volume and by the rock properties.

All holes were drilled and charged in a single charging operation. The upper part was drilled with a production drill rig (76-89mm hole diameter) and the lower part with either the production drill rig (76-89mm hole diameter) or the development jumbo (48 mm hole diameter).

The lower part of the blast (figure 4) was initiated with Exel™ non-electric detonators or ikon™ detonators and the upper part with wireless WebGen™ primers. A minimum of 1.5m collar length and spiders ensured that over break of the back did not drop any WebGen™ primer into the muck pile.

CASE STUDY

Double Layer Blind Blast (DLBB) – WebGen™

Agnico Eagle Kittilä mine, Finland

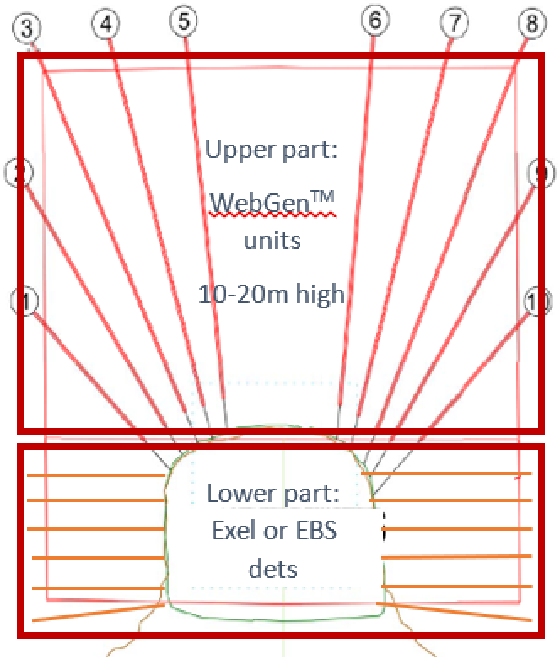

Figure 4. Drill design for transverse Double layer blind up hole stope.

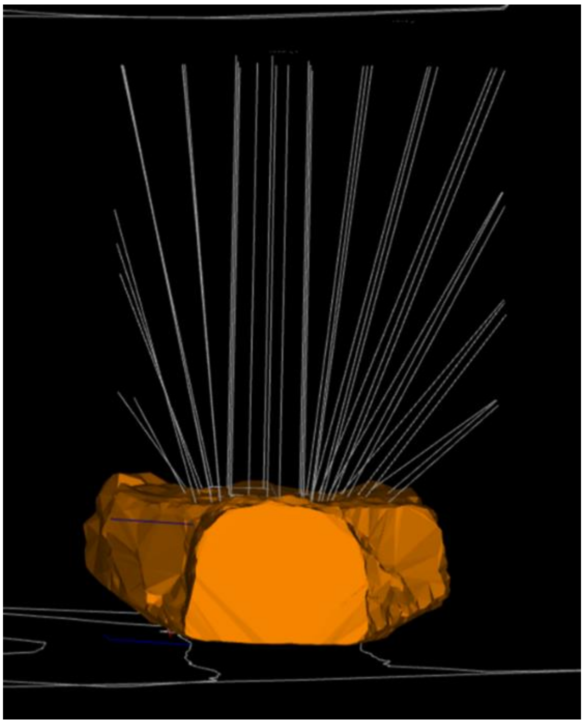

Figure 5. Transverse stope. Widenings blasted and loaded.

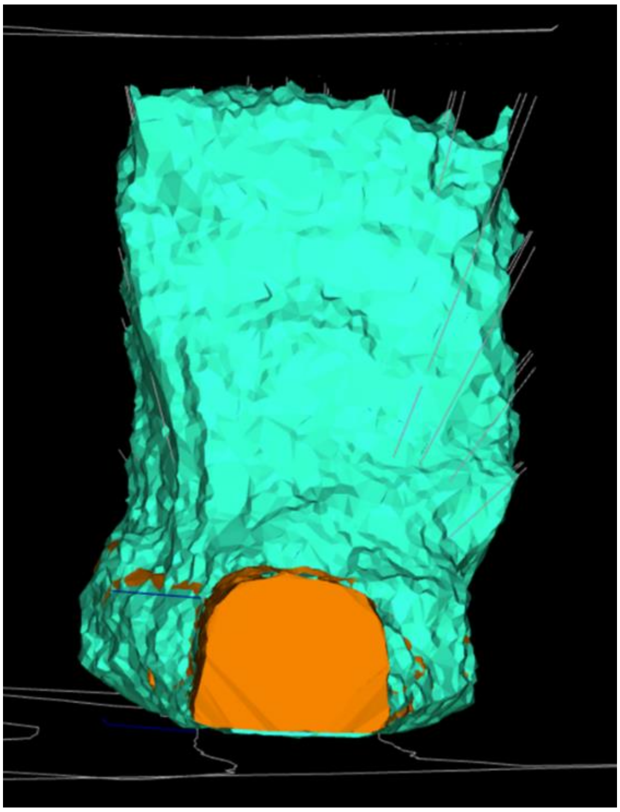

Figure 6. Transverse stope. Blast results after the second (upper) part.

Testimonial

At Kittilä mine wireless initiation system created great opportunities to improve production cycle times and optimise annual development meters. The orebody is relatively narrow, and more than 200 stopes need to be blasted annually. WebGen™ can help us to extract more ore and speed up cycle times. Even small changes have a great effect. Most of the stopes are blasted downhole and with traditional EBS, but WebGen™ gives us the possibility to do more up-hole blasts which were previously difficult to execute. Up hole stopes can also be designed much larger due to pre-charging and blasting in sequential blasts.

Jani Ollikainen
Mine Engineer Manager, Agnico Eagle Kittilä Mine

ORICA

orica.com

Public

CASE STUDY

Double Layer Blind Blast (DLBB) – WebGen™

Agnico Eagle Kittilä mine, Finland

Acknowledgements
Orica wishes to thank Agnico Eagle Kittilä for their support and permission to publish this case study.

Author: Jari Näsi
Date: 2021-04-12