



Powerful New Version of a Proven Shaft Enlargement Technology in Mining

Herrenknecht AG has developed a next generation of the rodless shaft enlargement machines that have been established on the market for decades as so-called V-Mole technology. Herrenknecht worked closely together with two very experienced companies highly renowned in the mining industry, Thyssen Schachtbau and Murray & Roberts Cementation, to update and adapt the technology to current conditions and requirements. The result is the SBE (Shaft Boring Machine for Shaft Enlargement). It facilitates high sinking speeds and maximum working safety for shaft boring using the pilot borehole.

Schwanau, Germany, July 21, 2014. With immediate effect, a next generation of shaft enlargement machines for shaft boring using the pilot borehole is available to the market. The Shaft Boring Machine for Shaft Enlargement (SBE) was developed by Herrenknecht AG in close collaboration with a joint-venture between Thyssen Schachtbau GmbH and Murray & Roberts Cementation. These two mining experts had approached the leading manufacturer of mechanized tunneling with the aim of applying V-Mole technology to the next high-performance generation.

With the newly developed shaft enlargement machine, Herrenknecht offers a modern version of shaft boring machines that complies with the highest standards of efficiency, safety and reliability. With this new generation machine, shaft boring diameters of up to 9.5 m can be realized under optimum conditions in hard rock. The machine concept allows significantly higher sinking speeds compared to earlier shaft boring generations. It is robustly designed to handle the tough working conditions found in sinking of shafts. Qualified personnel can easily operate the system.

The SBE basically works like modern hard rock TBMs, but vertically. Advance and primary shaft lining are carried out simultaneously. With the help of laterally extendable hydraulic cylinders the 15 meter high and 350 metric ton machine braces itself before every drilling stroke in the shaft steadying the machine, allowing the thrust cylinders to push the rotating cutterhead against the borehole floor. Hydraulic cylinders ensure precise vertical alignment of the shaft boring machine to the target axis. This is constantly transmitted to the machine operator by a laser aiming device.

The rotating anchor platform is located on the drilling deck above the cutterhead. From there anchors and steel mesh can be put in place by two powerful hydraulic drill rigs. If required, a shotcrete unit on the shaft boring machine secures the shaft wall immediately after exposure of the rock outcrop. The machine operator controls all operations safely and conveniently from the interior of the machine.

The sinking of a shaft with the new SBE occurs in three phases:

- First a pilot hole is created from the top downwards, which sets the vertical target axis.
- Once at the bottom, workers in the cavern replace the drill bit with a reamer, which then enlarges the pilot hole from bottom to top until the pilot borehole diameter is reached. The muck is continuously loaded at the foot of the borehole and transported away.
- Thereafter, the shaft boring machine enlarges the pilot borehole from top to bottom to the final diameter and installs the primary lining of the shaft in parallel. The shaft depth is only limited by the technically feasible length of the pilot borehole.

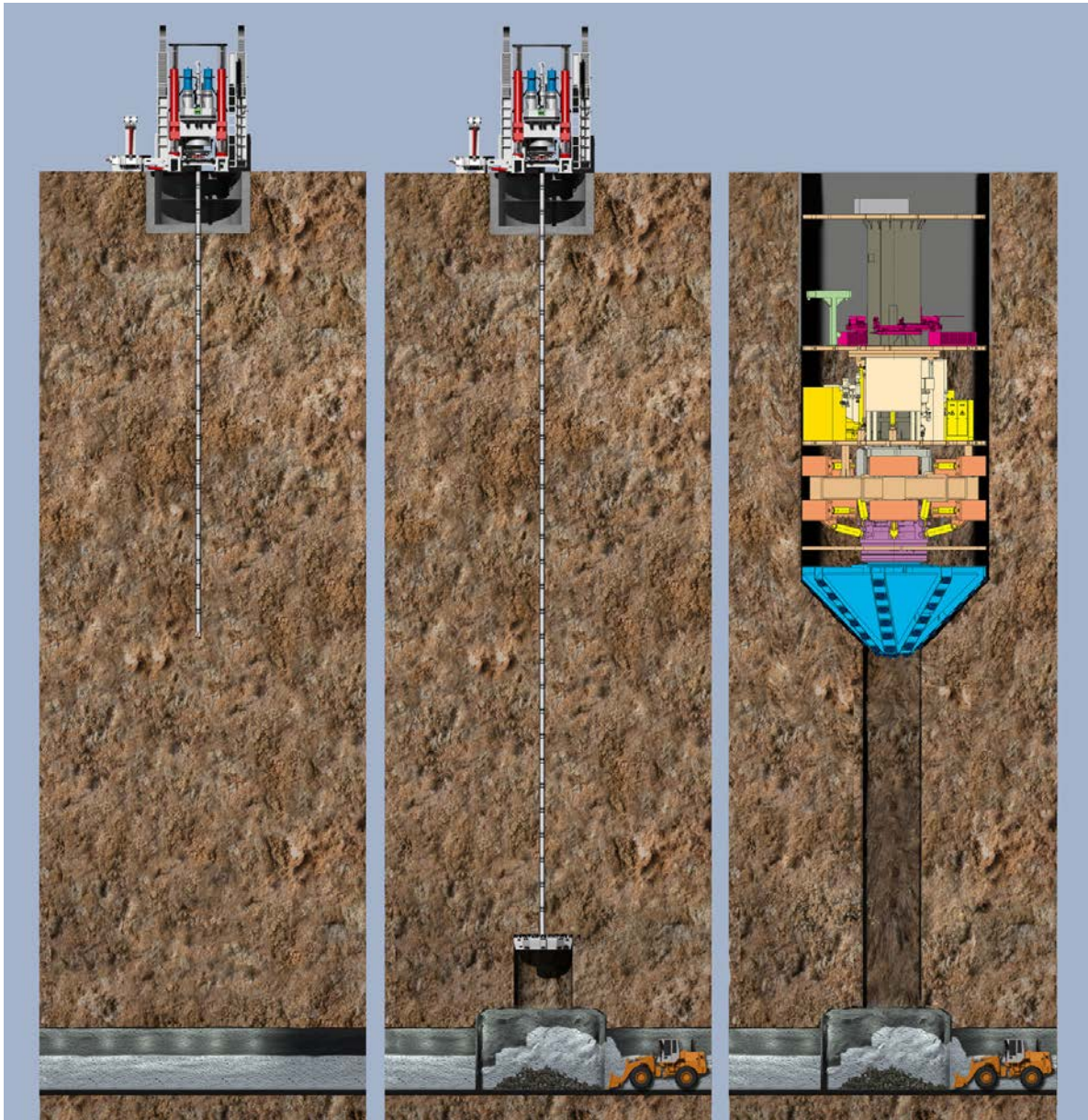


Fig. 1: Operating principle of the shaft enlargement machine for shaft boring using the pilot borehole

With the SBE shaft boring technology using the pilot borehole the shaft sinking time is reduced by 20% to 30% compared to conventional shaft sinking technology.

The high precision in terms of verticality and circular shape of the shaft cross-section as well as the virtually vibration-free ground treatment are further advantages of the shaft boring technology compared to the conventional shaft sinking method with drilling and blasting or, alternatively, in comparison to other mechanical methods. The sinking cycle runs continuously and is not interrupted by drill and blast times or dispersal of explosion gases. The new Shaft Boring Technology not only boasts high levels of efficiency but also that of greater levels of safety and ergonomic working conditions.

Technical data Herrenknecht SBE

| | |
|------------------------|---------------|
| Drive power: | approx. 800kW |
| Cutterhead speed: | 0 – 5 rpm |
| Torque: | max. 3,300kNm |
| Feed force: | 12,000KN |
| Gripper bracing force: | 36,000KN |
| Drilling stroke: | 1,000mm |
| Machine weight | approx. 350t |

Herrenknecht AG

As the only company worldwide, Herrenknecht AG delivers tunnel boring machines for all ground conditions and in all diameters – ranging from 0.10 to 19 meters. The product range includes tailor-made machines for transport tunnels, supply and disposal tunnels and additional equipment and service packages. Furthermore, Herrenknecht manufactures drilling rigs for vertical and inclined shafts as well as deep drilling rigs. In the year 2013, the Herrenknecht Group achieved a total output of 1,027 million euros. The Herrenknecht Group employs around 4,800 members of staff worldwide, among them 200 trainees. With 82 subsidiaries and associated companies working in related fields in Germany and abroad, Herrenknecht provides a comprehensive range of services close to the respective project and customer.