



Strabag AG builds sustainable tunnel systems with individually designed machines

As a European technology group for construction services, Strabag AG implements complex construction projects that go far beyond classic road construction. Strabag SE, to which the German Strabag AG belongs, can look back on more than 90 years of tradition as one of the market leaders in traffic route construction. The portfolio includes all areas of the construction industry and covers the entire construction value chain. Strabag AG is represented in around 30 countries worldwide and has been active in the fields of building construction, civil engineering, tunneling and specialist foundation engineering in the UK since March 2011. The company continues to drive its business development activities, particularly in the area of tunneling and infrastructure developments.

For the realization of projects in tunnel construction, Strabag relies on individually designed machines from Progress Maschinen & Automation, a Progress Group company. For the project in North Yorkshire, Strabag built a precast plant on the construction site and ordered, among other things, an M-System BlueMesh mesh welding plant with mesh rolls, a Tunnel Master ladder welding machine and an EBA S 16 automatic stirrup bender.

Project of superlatives

In the north-east of England, in the middle of the North York Moors National Park, a 37 km-long transport tunnel system is being created. The Strabag North Yorkshire Polyhalite Project is part of the Woodsmith Project, which is owned by Anglo American, one of the world's largest mining companies. This



Left to right: Craig Sewell, Site Manager; Ernst Gschnitzer, Project Director; Kurt Usel, Expert and Developer and Project Manager Automation; Edgar Schömig, Company Section Manager Tunnel Construction Strabag; Giacomo Vollaro, Project Manager Segment Production

is to extract minerals from the world's largest polyhalite deposit, a mineral used in the production of fertilizer. Of the 2.66 billion tons of polyhalite deposits suspected for the site, 280 million tons are located within 5 km of the proposed mine. This represents only seven per cent of the project's stated resource area.



Production hall of the Strabag North Yorkshire Polyhalite project with the Progress machines



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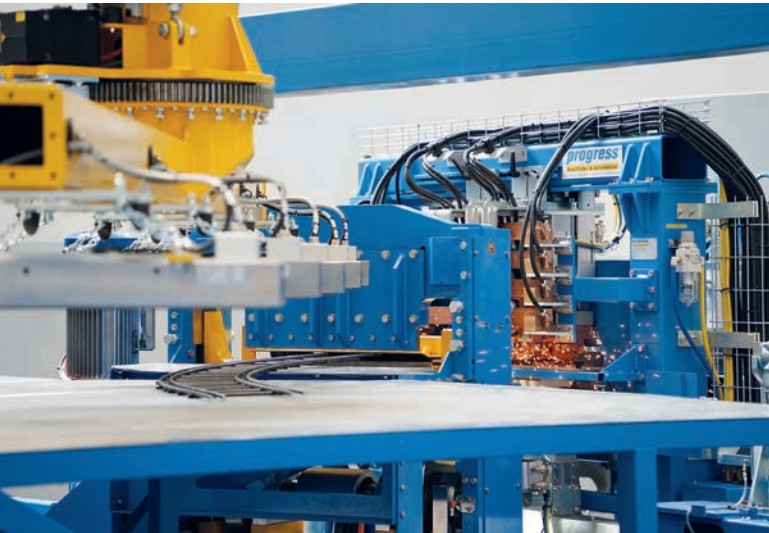
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The Tunnel Master uses computerised welding control to produce curved tunnel segments.



M-System BlueMesh for the production of customised reinforcing steel meshes.

The rapidly increasing and urbanizing world population continuously requires more fertilizer for efficient food production. Polyhalites are a sustainable solution for this. It is extracted from a depth of 1.5 km through mine shafts and transported underground by the MTS (Mineral Transport System) to the processing hall in Teesside for processing. After processing, the product is driven to the port and mainly exported overseas.

Strabag was able to secure the contract for the planning and execution of the 37 km-long tunnel including the transport system.

Major challenges at peak times

The biggest challenges in tunnel construction are the safety precautions and the evacuation strategy. High safety standards, a tight schedule, historic funding issues and contractual changes have added challenges to the project over time. The close cooperation with the client's team on site made it possible to achieve the best possible results.

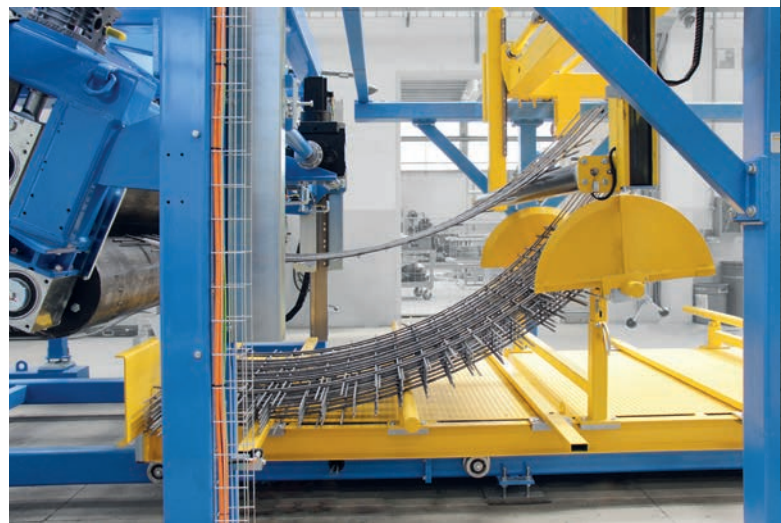
For more sustainability

From the design phase onwards, the project focused on sustainable, environmentally friendly construction methods. The MTS itself is an environmentally friendly measure for the mine without the use of roads or other surface transport. The precast plant that was built close to the site also fits into this concept. The sustainable procurement policy guides the approach to the supply of raw materials. It was decided early on to source sand and aggregates from local quarries, and the transport routes were specifically chosen so as not to disturb the tranquility of the national park. The modern diesel-electric hybrid tunnel locomotives use kinetic energy recovery to

make maximum use of the steep profile and length of the tunnel, radically reducing emissions and minimizing ventilation requirements.

Efficient production of lining segments

A lining segment is a component of the outer shell of a mine shaft or tunnel. At the Redcar site, a town in the county of North Yorkshire in England, the tunnel construction elements are produced in a field factory, thus avoiding long transport routes. The entire production line was designed for a tunnel boring machine feed rate of 20 m per day. The expected productivity was achieved by using local workers, many of whom had no experience in lining segment production. After



With the device for rolling the meshes, reinforcement meshes can be bent upwards as well as downwards.



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The prefabricated ladders are welded together with the reinforcement meshes by the welding robots (visible in the background) to form the finished cage for tunnel elements.

a learning curve of only about 3 months, the workers were trained. Despite a higher than expected rate of more than 17 rings per day or 26 m of tunnel, the lining segment production was exceeded by the daily TBM excavation rates of up to 52.65 m. Innovations in lining segment production were also the use of robot assistants and automated welding for cage production.

Many years of experience in challenging tunnel projects

For the joint tunneling projects, Progress Maschinen & Automation has worked out individual solutions with Strabag, ensuring high quality and functionality of the end products. For this purpose, a special mesh welding plant from the model series M-System BlueMesh was designed with a device for rolling the mesh. This flexible production plant can weld reinforcing steel meshes from the coil according to individual specifications and thereby fulfil the requirements very well. The required production data is taken from the structural engineer’s software using a bending list, processed accordingly and transferred to the machine. This means that the correct lengths and spacing of the bars can be precisely prefabricated.

The Tunnel Master ladder welding machine from Progress is used for the production of straight and bent ladders from the coil. The robust and low-maintenance welding machine is designed for fast and cost-saving production of reinforcements for tunnel segments. The Tunnel Master processes up to four longitudinal wires and arranges them, along with the cross wires, with the help of a continuously adjustable grid. Thus, this plant enables the fast, technically sophisticated, and cost-saving production of straight and curved ladders from the coil for tunnel segments and similar precast concrete elements.

In combination with the fully automatic stirrup bender, Progress offers a complete solution for the production of

reinforcements for tunnel segments. The automatic stirrup bender belongs to the EBA S-line and covers the performance segments in the wire diameter range 6 to 16 mm. The EBA S automatic stirrup benders are easy to operate and, thanks to the integrated high-quality control, very high outputs and accuracy are achieved. Particularly high flexibility as well as low costs for operation, maintenance, and wear parts characterize this latest generation of machines.

Total solution for reinforcements in tunnel construction

The prefabricated ladders, meshes and stirrups are welded together fully automatically by special robots to form the finished reinforcement cage. The complete reinforcement for the tunnel construction project in North Yorkshire is thus prefabricated automatically and quickly with the Progress machines.

“The cooperation with Progress to develop the equipment for this special application was excellent,” says Kurt Usel, expert, developer and project manager for automation at Strabag AG, adding: “Especially for such prototype developments for an ongoing construction site operation with few



Strabag AG’s S-1175 tunnel boring machine.



Temporary storage of the lining segments - the concreted prefabricated elements for the outer shell of the tunnel

testing possibilities, intensive teamwork is necessary. This cooperation has led to success and we have been producing the parts needed for robotic welding with the required quality and quantity since autumn 2020."

Progress' overall plant concept is in line with Strabag's objective and paves the way for the plant to manufacture quality products with few variables in the production processes and to remain competitive in the long term. The continuing trend towards more automation is also recognizable in the processing of reinforcing steel. Construction companies can work with Progress to take advantage of automated processes to increase efficiency. ■



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