Schöck Bauteile GmbH
Vimbucher Strasse 2
76534 Baden-Baden
E-mail: presse-de@schoeck.com

Case study

Trouble-free tunnel construction under Munich Hauptbahnhof

Glass-fiber reinforcement Schöck Combar was used to reinforce the diaphragm walls

Baden-Baden, in November 2021 - Approximately 840,000 passengers will use the Munich S-Bahn every day, and it is now therefore reaching its capacity limits. The construction of a 2nd main line between Laim and Leuchtenbergring should eliminate bottlenecks and enable faster connections. The centerpiece of this project is a tunnel stretching seven kilometers. Diaphragm walls were built for the "Munich Hauptbahnhof" stop to a depth of 40 meters, which will later be cut through using tunnel boring machines. Glass-fiber reinforcement Schöck Combar was used in this area. In contrast to the use of steel rebar for reinforcement, these components are easy to machine, and the tunnel boring machine can also drive through them much more easily and efficiently. This reduces both construction time and construction costs.

There is already heavy train traffic under Munich Hauptbahnhof due to the routing of the 1st main line and other underground trains under the station. And now the new 2nd main line will also be running here underground. The stop, which is scheduled to be completed in 2028, is being constructed 40 meters below the surface and thus at a safe distance from the existing tunnels of the other lines.

Tunnel construction using diaphragm wall and cut and cover construction

In order to secure the excavation pit for the new S-Bahn station, 1.50 meter-thick concrete walls were built using the so-called diaphragm wall construction method. At the same time, they form part of the outer wall of what will later be the central stairway leading to the stop from the surface. Special excavators equipped with claws that are 3.20 meters wide for excavating and cutting the ground for diaphragm walls created 1.50 meter wide slots 56 meters deep. The 96 concreted wall elements form a closed construction pit wall. The construction work was finished within a year.

Soft eye areas for tunnel boring

The tunnel for the 2nd main line was bored through the western and eastern excavation walls. Two openings each had to be planned: one for the later rail tunnels, and a smaller one for the exploration and rescue tunnel to be located in between the rail tunnels. These areas were designated as so-called “soft eyes.” Instead of steel, Combar was used as the reinforcement material, a glass-fiber-reinforced polymer (GRP) that has been specially developed and produced by Schöck. The special reinforcing bar consists of glass fibers that are bound by a vinyl ester resin. In contrast to steel, GRP can be easily machined. Thus, the tunnel boring machine can drive through the shaft wall at this point smoothly and without damaging the cutting tools. Combar is very strong in the longitudinal direction of the fibers. However, these fibers can absorb significantly less transverse shearing force. This is why GRP is easily machinable.

Existing approval simplifies planning

Ralf Meyer, Senior Construction Manager at ARGE Tunnel for Munich Hauptbahnhof and the responsible manager for special civil engineering at the Munich Hauptbahnhof train station, explained: “The client already stipulated the use of the reinforced material made of Schöck Combar in the tender and contract documents. It is already approved as a construction product in Germany. As a result, we were able to immediately start planning without any additional permits.“

Combar in custom lengths

In the soft-eye area, reinforcement cages made of Combar were placed throughout a 24-meter area, and they had to be connected to the steel reinforcement cages below and above when they were inserted into the slices at the construction site. A total of four cage segments were connected to one another in order to achieve the required length of 56 meters. In emphasizing the special nature of this unusual project, Ralf Meyer noted: “It doesn't often happen in Germany that you need cages that long”. The overlapping joints between the individual cages were secured using wire rope grips. The special 18-meter-long Combar bars proved to be advantageous for creating the shaft walls. They made it possible to create a single reinforcement cage. Thus overlapping joints between the two cages in the soft-eye area were avoided and the reinforcement density was reduced.

Enhanced time savings during the construction process

Ralf Meyer explained, “The special lengths of Combar bars afforded us many advantages for the construction process. On the one hand, they saved us from having to perform time-consuming connection work. On the other hand, this gave us the opportunity to fabricate the floor recesses for the floor elements in the overlapping area in advance instead of having to suspend them from the cage joints at the construction site.” Therefore, we were able to start the concreting work immediately, which is a kind of work in everyday construction practice that must be completed by the end of the day. The conclusion of the Senior Construction Manager at ARGE Tunnel Hauptbahnhof is positive: “Ultimately, we were very happy with the way the project turned out. The engineers and application technicians from Schöck provided us with great support, from the planning discussions and answering our questions about dimensioning to the on-site execution. We were able to complete the diaphragm walls on schedule in May 2021.“

5,431 characters, including spaces

Video

Installation of the reinforcement cage made of Combar and steel into the ground:
https://youtu.be/SCiQHitRB3o

Construction site

Client: Deutsche Bahn

Construction companies:

ARGE Tunnel Munich Hauptbahnhof, 2nd S-Bahn main line,

Wayss & Freytag Ingenieurbau AG, Southern Region

Max Bögl Stiftung & Co. KG

Ed. Züblin AG, Tunnel Construction Office

Bauer Spezialtiefbau GmbH, Schrobenhausen

Structural engineer: SSF Ingenieure AG, Munich

Bending service: Brühler Stahlhandel GmbH, Brühl

Construction period: Construction of diaphragm walls: April 2020 – May 2021

Schöck products: Schöck Combar

Info boxes

Steel has been used as the most important reinforcement material in concrete construction for decades. In certain application areas, such as special civil engineering projects, buildings for scientific research, or energy system structures, the material properties of the steel bars do not meet the given requirements. In these cases, Schöck Combar opens up new application possibilities thanks to its extraordinary properties: In addition to corrosion resistance and electromagnetic neutrality, these also include easy machinability, minimal thermal conductivity, and particularly high tensile strength. This makes Combar a superior alternative to steel when it comes to reinforcement. When it comes to installing it at the construction site, however, Combar does not differ from conventional reinforcing steel, so no special training is required before processing.

Image captions

[Schoeck_Main_Line-Munich_1]

The special 18-meter length of the Combar bars proved to be advantageous for the construction of the shaft walls, because this allowed for the construction of only one reinforcement cage.
Photo by: Moritz Bernoully

[Schoeck_Main_Line-Munich_2]

In the soft-eye area, reinforcement cages made of Combar were placed throughout a 24-meter area.
Photo by: Moritz Bernoully.

[Schoeck_Main_Line-Munich_3]

The overlapping joints between the individual cages were secured using wire rope grips.
Photo by: Moritz Bernoully.

[Schoeck_Main_Line-Munich_4]

Combar was used as the reinforcement material instead of steel. It is a glass-fiber-reinforced polymer (GRP) specially developed and produced by Schöck, which, unlike steel, can be easily machined.
Photo by: Moritz Bernoully.

[Schoeck_Main_Line-Munich_5]

Thanks to its special properties, Schöck Combar is a superior alternative to steel for reinforcement.
Photo by: Schöck Bauteile GmbH

About Schöck:

Schöck Bauteile GmbH is a subsidiary of the multinational Schöck Group with 14 international sales offices and approximately 1,000 employees. The company's success story started in 1962 in Baden-Baden at the edge of the Black Forest. The company's founder Eberhard Schöck applied his knowledge and construction site experience to develop products that streamlined construction and solved complex problems in building engineering. This mission has formed the foundation of the company's philosophy to this day. It has made Schöck into one of the leading providers of reliable and innovative solutions to reduce heat bridges and impact sounds and to create thermally insulating and secure facade fasteners and reinforcement technology. Schöck products make smart construction methods possible and ensure consistent construction quality. Addressing building engineering and energy efficiency needs are the company's top priorities. To meet the construction needs of tomorrow, Schöck is driving the adoption of digital technologies in all areas, from workflows and planning to the construction site.