

Guadarrama Tunnel, Spain (2 Back-up systems)



Assembly at the manufacturing plant in Le Creusot, France



Assembly at the construction site at the northern tunnel entry, autumn 2002



The installation is leaving day-light

Editorial

Dear Reader

This issue deals with the project Guadarrama, which is extremely interesting in every respect. You will find here information about the project in general, about the Rowa installations in operation and about the first experiences from the headings, which have both reached about 4 km (of the total of 14 km).

Project and Objectives

The project is a key part of the high-speed rail link between Valladolid and Madrid. It consists of 2 single-tracked tunnels suitable for high-speed trains (designed for 350 km/h) with a total length of about 28.5 km each. The two tunnels are connected by cross passages every 250 m.

4 tunnel boring machines are operating simultaneously, each one having to cover about 14 km. Upon an order from WIRTH, Rowa was able to develop and supply to two different Joint Ventures two installations meeting their high expectations, one attacking from the north, the other one from the south.

The Customer's Opinion

Detlef Jordan, General Manager MSO WIRTH Group



"Rowa has developed and supplied to the WIRTH company two complete back-up installations for the project Guadarrama, which is a very demanding project, technically as well as with regard to its handling. Both installations are designed to meet the specific requests of the final customers and both comply with the very high performance requirements.

Upon request of WIRTH, Rowa has assumed responsibility for the supervision of the assembly of the back-up systems. Afterwards, Rowa instructed the staff on the construction site for the commissioning and the start-up period, and thanks to this assistance both final customers achieved excellent advance performances immediately after the short start-up period. We are convinced of having supplied to the two final customers, with Rowa's support, two high-quality heading installations with a high performance potential."



Workplace for the back-filling of lining segments



Lining segment magazine with material transloading area



Transloading and intermediate stockage of pearl gravel (17 m³) for the back-filling of lining segments

Project Data

Country	Spain
Owner	GIF (Gestor de Infraestructuras Ferroviarias), Spain
Mandator	WIRTH Maschinen- und Bohrgeräte-Fabrik GmbH, Erkelenz
Final customers	Joint Venture North: FFC, ACS, Ferrovial Joint Venture South: Necso, Dragados, OHL, Sacyr
Total tunnel length	about 28 km
Rowa's order	Supplying 2 high-performance back-up installations
Type of heading	Double-shield hard rock tunnel boring machine
Task of the back-up systems	Supply and removal for a high-performance tunnel boring machine with installation of lining segments
Location	Tunnels north west and south east
Heading length	14'500 m for each back-up installation
Inclination	max. +1%
Excavation diameter	9.46 m
Internal diameter of lining segments	8.5 m
Lining segment construction	screwed and sealed
- Lining segment thickness	320 mm
- Lining segment length	1'600 mm
- Number of linings	7 units
Soundage drillings	in the ridge area
Double-tracked supply	2x900 mm gauge
Removal	continuously on extensible back-up tunnel conveyor



Dry mortar transloading and intermediate storage for bottom segment back-filling



Rail-laying area with stockage of the daily requirements



Segment unloading, lining segment transloading crane with vacuum gripper

The concept

The Rowa back-up systems north and south comply with the extreme performance requirements thanks to the high-performance logistics with the adequate equipment. The logistical system is designed to function during the advance with the double-shield tunnel boring machine simultaneously with the segment construction. The lining segment construction takes place continuously and has to be interrupted only for 2 minutes for the re-positioning of the gripper shield. This allows to achieve advance rates of 1.6m (lining segment length) in 20 minutes, corresponding to a maximum advance rate, segment construction included, of 4.8m/h.

Supply logistics

Each supply train carries the necessary material for an advance of 3.2m. The quick segment unloading system allows the material to be unloaded in less than 8 minutes. The following components can be transported to the site and unloaded every 40 minutes:

- 2 complete lining segment rings (14 lining segment stones)
- Back-filling components
- Dry mortar 4.5 m³
- Pearl gravel (south) or wet mortar (north) 2x8.5 m³

The intermediate storage of the daily requirements of the following components is possible in the back-up system:

- Pipes for cooling, industrial and sewage water
- Rails for the double-track installation in the tunnel
- Conveyor elements for the tunnel conveyor
- Auxiliary material

At the rear of the back-up installation there is a double-track rolling platform for the reversing of the locomotive, which is always at the head of the train, on the way in and on the way out of the tunnel.

Removal logistics

The removal of the excavated material takes place continuously from the tunnel boring machine conveyor through two suitable back-up conveyors to the extensible tunnel conveyor, integrated in the back-up system. The removal capacity of the installation amounts to 1'150 t/h and complies thus with the high performance requirements.

Experiences

The heading teams of the final customers were participating already in the assembly. During the commissioning by the Rowa specialists the operating staff received additional instructions. An additional support was provided during about a month by a Rowa commissioning engineer, which accelerated the learning process of the heading staff.



Stockage and installation area of pipes



Pile of segment linings on the supply train



Rear of the back-up system with front of the rolling platform

After a short start-up period considerable daily performances could be achieved.

In order to realize the daily performances of over 100 m made possible by the tunnel boring machine and the design of the back-up system (provided the geological conditions allow for boring strokes of 1.6 m in 18 minutes), the logistics of the construction site have to come up to very high expectations

On the construction site, the high efficiency of the system has resulted in daily peak performances of over 60 m and a monthly record performance of over 980 m.

We congratulate our customers for these impressive performances and are glad to have been able to contribute to this success by our Rowa installations.

Special features

The Guadarrama project is characterized by various special features.

Tunnel length

The two parallel single-tracked tunnels, which are 40 m apart and over 28 km long, are being excavated by 4 partial headings of about 14 km length from the 4 tunnel entries, without any infrastructure in between. The only access to the heading for people and material and the only escape way is through the tunnel entries.

Geology

The geological conditions allow the use of hard rock tunnel boring machines achieving for long stretches good advance rates with high penetrations. However, there are also various trouble zones with difficult conditions for an advance by tunnel boring machine.

Heading installations

In order to realize a short construction time the contractors took the decision to choose heading installations with a maximum peak performance. . They purchased double-shield heading installations with a back-up logistic system suitable for peak daily performances of over 100 m.

The four headings were equipped with 2 Wirth installations and 2 Herrenknecht installations.

One Wirth installation and one Herrenknecht installation are operating side by side, with a distance in between of 40 m, so that practically identical geological conditions can be expected for both of them. This comparability of heading installations from two different suppliers is unique in its kind.