

## More than 12'000 m of the Gotthard base tunnel Amsteg, section 252, are already excavated



Construction site Amsteg section 252

### Editorial

Dear Reader

Since May 27, 2003 – the day when the tunnel boring machine started on the eastern tunnel – 6'170 m of the eastern and 5'970 m of the western tunnel have been excavated. This gives us the opportunity to inform you about our experiences.

The order placed with Rowa Tunnelling Logistics AG in connection with this project comprised the development, manufacturing, supply, assembly and start-up of two back-up systems and an installation for the excavation of the cross passages.

### The customer's opinion

Dipl. Ing. Michael Holzhuber, project manager AGN AG



With regard to the back-up system it turned out that Rowa's logistic system proved to be a success, even though a few isolated possibilities for detailed subsequent improvements appeared during the practical operation. Rowa is flexible enough to take such opportunities into account and to continually improve the design during the advance operation. The availability guarantee agreed upon by the contract could be by far exceeded. The system corresponds wholly to our expectation. The new type of cross passage installation proved to be, after the experiences accumulated up to now, exactly the ideal solution. It helped to simplify the logistics and to increase the safety level.



General plan of the project

## Project-Data

## Situation: 02.03.05

Tunnel length	11'350 m
Excavated diameter	9.58 m
Inclination	4.08 ‰
Curve radius	>5'000 m
Typ of heading	Gripper-TBM
Tunnel finishing	Shotcrete with concrete invert construction by conveyor
Muck handling	Already excavated tunnel east 6'170 m
Already excavated tunnel west	5'970 m
Average daily performance	about 20 m
Peak daily performance	over 30 m

## Operation and experiences

### Shotcrete robot in the area LZ

Owing to its optimized longitudinal manoeuvrability the shotcrete robot didn't create any waiting periods, in spite of the high rates of advance. However, the experiences demonstrated that it was necessary to reduce the amount of dust produced. This task was attacked in cooperation with the supplier of the concrete, and a further optimizing of this aspect is in work.



Shotcrete robot in the area LZ

### Invert construction area

In the invert construction area, the choice of a suspended construction has proved to be successful. This design creates the necessary free space for the concreting to be effected independently from the rate of advance.

### Rock crusher

The rock crusher, integrated in the back-up system is, used for breaking up the excavated material, which in this geological formations occurs mainly in large blocks. In addition, the rock crusher guarantees the uninterrupted removal of the material on the continuous conveyor.

During the planning period, it could not be demonstrated without doubt that a rock crusher was needed at all. However, the practical experiences showed that the decision to install one was correct, since the incidence of large rock blocks was even higher than expected.

On the other hand, it could not be avoided that consequently the material wear was somewhat higher than expected.



Rock crusher



Suspended platform

### Suspended platform

In comparison with the use of a bridge construction the principle of a suspended back-up system has proven to be successful. Since a suspended platform doesn't need any supports, there is additional free space available for the operations following the heading. The length of the suspended platform had previously been optimized in cooperation with the contractor.

The suspended platform proved to be advantageous not only for the invert construction area. In addition, the unimpeded and free installation of the supply pipes and ducts was thus possible.



Monorail suspended from the tunnel roof

### Independent monorail

In order to bring consolidation material, shotcrete, installation material and waste material up to the respective workplaces without additional transloading, a monorail was suspended from the tunnel roof. This monorail can be operated independently from the rest of the back-up system.

Thanks to the high capacity and flexibility of the monorail, all the workplaces can be supplied with enough material even the daily performances are much more than 30 m.



Assembly

### Starting period

The installation of the back-up system was effected in two steps, so as to keep the launching chamber as short as possible. The tunnel boring machine started working with a back-up system reduced to the essential. After the excavation of the first 500 m, the advance was stopped and the second part of the back-up system installed.

Thanks to the detailed planning of the assembly and the optimized logistics planning, the tunnel boring machine could resume its full operation after a very short interruption. The assembly of the back-up system in two steps proved to be a significant advantage, since the reduced length of the launching chamber allowed an earlier operation of the tunnel boring machine and thus a quicker advance. The waiting period for the installation of the second part of the back-up system was more than compensated.



Cross passage installation

### Cross passage installation

Thanks to a new development, realized by Rowa, the cross passages can be excavated simultaneously with the main advance. The installation, designed especially for the cross passages, distinguishes itself as expected by its efficiency and the practical experiences demonstrated in addition many advantages with regard to the general safety for people and material. This can be achieved because the entire material is stored and transported on a facility designed especially for this purpose and there are no manual transport operations or interim stockings. The installation for the cross passages can be moved longitudinally on the same rails as the back-up platform. This allows the installation to be moved forward and backward for the various work cycles, and then to be moved into position for the next cross passage to be excavated.



Profil

### Conclusion

For the back-up system and the installation for the cross passages in the Gotthard base tunnel Amsteg, section 252, a lot of development work was necessary. By doing this, Rowa opened up new territory.

Now, after about half of the distance is excavated, it is possible to draw positive conclusions:

- the availability of the equipment as agreed upon by the contract could be clearly exceeded;
- if the present performance could be maintained, the tunnel would be finished one year earlier than planned;
- up to now, there were no serious accidents in the section 252. This fact confirms the suitability of the safety measures taken;
- some problems, like for instance the too high dust concentration through the use of the shotcrete robots, have yet to be solved, but they do not impede the performance of the TBM heading.

After the first half of the advance operation it can thus be concluded that the adopted course is promising and that the well-tried installations, supplied by Rowa Tunnelling Logistics AG, as well as the new ones, can be operated exactly as planned.