Rowa Customers Open Day

Highly Mechanised Heading Installation Gotthard South

Gotthard Base Tunnel
Sedrun, Construction Section 360

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1 Content

The heading installations in Sedrun for the Gotthard Base Tunnel are of central importance for the Rowa company.

Time-proven concepts are being used on the one hand and new, innovative systems are being developed on the other.

The Rowa Tunnelling Logistics AG company is offering a comprehensive all-in system in the heading installations from Sedrun towards the north and south.

The system is being further-developed constantly in order to achieve optimum benefit for the Transco joint venture.

We shall outline the experience we have had with the heading installation in a northerly direction in the first part of this talk. The main part of the talk presents the Gotthard South heading installation with the disposal concept. We will venture to present an outlook to conclude.
2 Status of the work in Sedrun, Construction Section 360

The Sedrun site includes the following main components:

- Access drift with a length of 1000 m
- 2 lift shafts with a depth of 800 m
- Multi-function point, split into east tube and west tube with the
- division into a south heading and a north heading

Source: AlpTransit Gotthard AG

The part already excavated is shown in red.
Expressed in figures as per September 14 2005, this means:

Northerly direction:
East tube: 1,382 m
West tube: 1,384 m
of a total of approximately 2,100 m

Southerly direction:
East tube: 1,960 m
West tube: 1,972 m
of a total of approximately 4,200 m
(not including option)

The Sedrun construction section makes very stringent demands of the tunnel builder and installation designer owing to the circular excavation cross section up to maximum 13 m diameter and the difficult geology.

The high convergences pose a major challenge. A solid steel reinforcement with two concentric bell-shaped sections with friction connection to accommodate these convergences is to be used to cope with the deformation with a radial extent of up to 0.7 m.

Large quantities of radial and face rock bolts are being used to provide additional support for the face.

The shotcrete shell will be placed in what is called the resistance phase after the deformation phase (approximately 70 cm) when the glide paths of the installed steel are exhausted.
3 Experience gained with northern heading installation

Experience has shown that the learning curve for this highly mechanised heading was less steep and so took more time than anticipated.

However, the performance targets will be reached or even exceeded after the introductory and optimisation phase.

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<td>VII</td>
<td>mechanical</td>
<td>0.6 m/working day</td>
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*) not allowing for difficulties/obstructions

Conclusion:

The "suspended installation" concept used here has proven its worth. The essential advantages of the northern heading installation are as follows:

- Creation of a second working level
- Rational, direct supply to the working points with the suspended heavy-duty crane with a carrying capacity of 20 metric tons
- Safe, efficient placement of steel rings

All measures taken provide high performance and safety when tunnelling.
This illustration shows steel placement mechanised with the displacement manipulator.

Pre-assembled arches, matched to the corresponding section type, on the pre-assembly unit. The arches are moved from here directly to the placement point.
The pre-assembly unit allows arches for section types SA4.1. to SA4.4 to be assembled.

Here we can see a view towards the heading with the suspension platform.
4 Gotthard South heading installation

Special construction-engineering demands applicable to heading installation

The Sedrun construction section makes stringent demands of the Gotthard South heading installation. All construction materials and machine sections are supplied and transported away via the access drift and the two vertical conveyor systems. The vertical link is the bottleneck to the multi-function point and its headings to the north and south. Every element for the entire heading has to fit in the lift to the side and spatially.

The complex tasks can be compared to constructing a high-rise building on which a lift is used instead of a crane. This means that all elements such as bricks, scaffolding, concrete and steel girders need to fit in the lift which transports them to the placement point. This is Sedrun.

The construction-engineering demands made of the heading installation are as follows:

- Consistent mechanisation of supply and disposal with a well-thought-out logistics concept from the face to the multi-function point
- High daily headway
- Trailing the concrete floor during driving
- Excavating muck when driving
- Efficient spoil-riding system
- Ventilation and cooling
- Dust-fighting
- Health and safety
On the basis of the layout, we shall explain how the overall system of the Gotthard South heading installation works. We shall then present a few special aspects of this installation.

The layout is subdivided into three sections: a front section, a centre section and a rear section. We will list the specified functions for each part.

**Front section:**
- Suction ventilation
- Impact roll crusher
- Towing conveyor
- Suspended infrastructure with:
  - cooling,
  - dedusting unit,
  - crusher,
  - transformer,
  - electrical wiring,
  - escape installation,
  - workshop and
  - compressor installation.
Centre section:
- Shotcreting equipment storage area
- Concrete floor site

Spanning the concrete floor site:
- Towing conveyor
- Ventilation
- Placement of floor concrete with heavy-duty crane

Rear section:
- Infrastructure train
- Continuous conveyor tail pulley
- Overlap towing conveyor – continuous conveyor 150 m
- Suspension platform for ventilation
Spoil-riding system

The excavated muck of the Gotthard east and west headings is disposed of with muck conveyors. One continuous conveyor is installed both for the east heading and for the west heading.

The installation was constructed subsequently so as to optimise both time and costs of the spoil-riding system.

The excavated muck is crushed with the Client’s impact roll crusher and deposited on the towing conveyor. The towing conveyor spans the concrete floor placement point and transfers the material to the continuous conveyor. The towing conveyor overlaps the continuous conveyor by 150 m.

The continuous conveyor is lengthened in this way every 150 m headway.

The conveyor structure is advanced during driving in parallel with track extension work.

The driving power and tension station from the eastern continuous conveyor is to be installed at the multi-function point and the driving power and tension station from the western continuous conveyor is to be installed above the transverse conveyor belt in construction-logistics cross passage No. 5.

The material from the east header is conveyed via the eastern continuous conveyor directly to the loading facility into the multi-function point. The material from the west header is conveyed via the western continuous conveyor as far as the construction-logistics cross passage and then via the transverse conveyor belt in the construction-logistics cross passage onto the eastern continuous conveyor.
The loading facility into the multi-function point is able to load the material directly into the cars of the muck train. The reversing conveyor features a flap in the discharge hopper allowing loading of two six-car muck trains parked adjacently and in parallel.

In addition, the material can, if necessary, be dropped into the bunker with the reversing conveyor. The material is loaded from the bunker into the cars of the muck train with a loading machine.
Ventilation/cooling
Owing to the stringent demands made of ventilation and cooling, we plucked up the courage to develop and install a mechanised suction ventilation system. The innovative feature of this system is the combination of fresh air supply and extraction with a telescoping airduct.

The main advantages of suction ventilation relate to:
- suction extraction of the blasting fumes
- clean air at the floor concrete working point
- discharge of dust when spoil riding
- fresh air supply in the unobstructed cross section in the suspension platform towards the heading
- heat dissipation by ventilation
- cooling machine in the unobstructed cross section (high level of flexibility in respect of location and number)

The disadvantages are:
- shunting the spiral airducts with each blasting operation
- dust deposits in the airduct train

The suction ventilation pipe must be able to be moved up to approximately 10 m in front of the tunnel face owing to the “suction ventilation” concept.
The telescopic pipe is retracted approximately 36 m in order to prevent it being damaged during blasting. This is made possible by allowing the front pipe to be retracted into the rear pipe. The outer and inner pipes are suspended from the time-proven suspension track system. A brush seal seals the connection between inner pipe and outer pipe.

This means that there are two main positions of the ventilation system:
- Telescopic pipe extended: approximately 10 m in front of the tunnel face
- Telescopic pipe retracted: approximately 46 m in front of the tunnel face

Longitudinal movement of the inner pipe is performed by a stationary, hydraulic chain drive. It is controlled as of the suspended infrastructure.
You can also see a schematic of the ventilation system on the suspension platform. Selecting a telescopic ventilation system required drastic measures relating to the design of the back-up system.

The main components of the ventilation system on the suspension platform are as follows:

- Continuous airduct
- Airduct storage cassette
- Ventilation airduct and overlap
Crusher installation dedusting
A dry dedusting installation is used owing to the anticipated high dust volume when crushing using an impact roll crusher and in order to extract dust from the various dust sources.

The various dust sources are as follows:

Dust source 1: Crusher loading point
Dust is produced when loading the crusher by the "Toro" loading machine. This dust is minimised by a large-area dedusting system above the feeding bunker.

Dust source 2: Crusher roll
The impact roll crusher features suction ducts for dust produced during the crushing process. The crusher housing is dedusted at these suction points.

Dust source 3: Dedusting of transfer point between crusher and oversize conveyor
The transfer point is enclosed and features sprinkler nozzles.

Dust source 4: Oversize conveyor dedusting
The oversize conveyor is fully enclosed.

Dust source 5: Transfer point between oversize conveyor and climbing conveyor
The transfer point is enclosed.

Dust source 6: Climbing conveyor
The climbing conveyor is approximately half-enclosed in the climbing zone.
5 Outlook

The high upward pressure on costs when working makes it necessary to further-develop conventional headings precisely in this context.

Together, the Transco joint venture - Sedrun and Rowa, we have taken a further step in mechanisation of the conventional heading in the Sedrun Project.

The performance of the heading installations has not yet been verified.

However, we are convinced that we will achieve our objectives in Sedrun. We want to further-advance

- workplace humanisation,
- workplace mechanisation and
- workplace rationalisation

and thus further-enhance economic efficiency with an optimum cost-benefit ratio.

I would like to thank all those involved for their constructive cooperation. It is a pleasure to work with you all.

If we tackle the common points of convergence - let’s not call them interfaces between divergent systems because all of us together have one goal and so want to converge to form one coherent whole with as few clashes as possible, we can also achieve this demanding goal.

Thank you for your attention.