Rowa Customer Day

From Mechanization to Automation

Automation within the back-up system to increase productivity and workplace safety
Using the TVM back-up train Wienerwaldtunnel as an example

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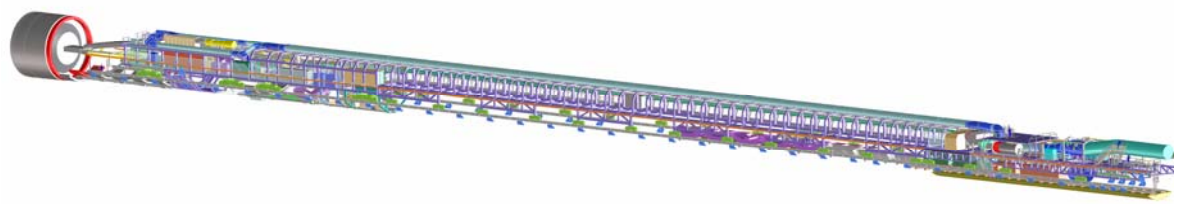


Content

1 Content

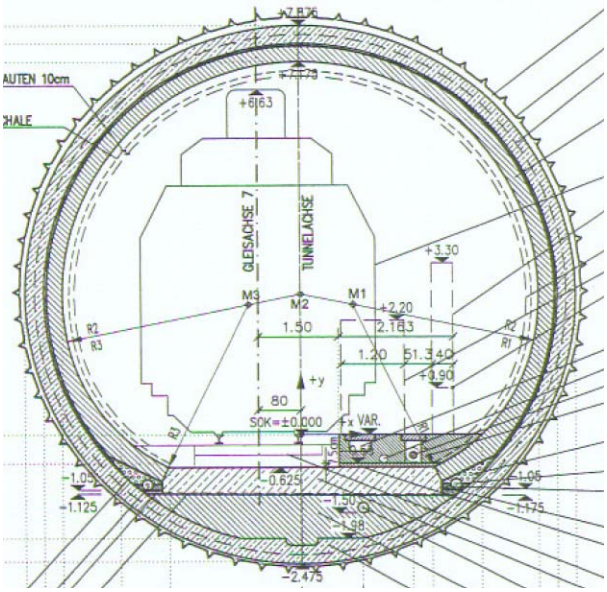
I have organized my lecture as follows :

2 Project outline

One of the main constructions of the new rapid train connection between Vienna and St. Poelten is the Wienerwaldtunnel.

The travelling time of the trains should be drastically shortened due to the two single track tubes of 10.9 km, each with an outbreak diameter of 10.6 m and cross passage connections every 300 meters.

Basically, the tunnel construction consists of the two long single track tubes and a 2.4 km long double track tube.



The concept for these tunnels outlines the construction of two single track tubes with segment lining. The segment lining is of a considerable length of 2.25 meters. In addition, floor concrete will be built into the heading area.

The interior timbering and walling is carried out in various phases and mainly consists of the in situ concrete lining, the cable tray with the wiring arrangements and the rail bed floor. Between the heading and the above final timbering and walling, cross passages are built..

3 Order

Rowa has received their order from Herrenknecht GmbH. This order comprises development, production, installation and starting up of two mirror inverted TVM-back-up installations with the following properties:

- Logistics for top performance of 54 m in 20h
- Floor construction made of in situ concrete with glider, integrated into the heading
- Minimum amount of personnel to operate the heading installation

Rowa has fulfilled the customer's requirements. To achieve this result, the various required work seuqences had to be precisely analyzed and the corresponding installations had to be developed. Subsequently, an innovative back-up concept was created.

The realized solution contains the following highlights:

- Automated lining segment transloading over great distances and
- automated transloading of back-up rails with special consoles
- Just in time wet mortar production on the back-up from three components
- Unravelling of heading and floor timbering and walling
- Highly mechanized floor concrete transloading and –installation in the back-up

4 The logistics concept

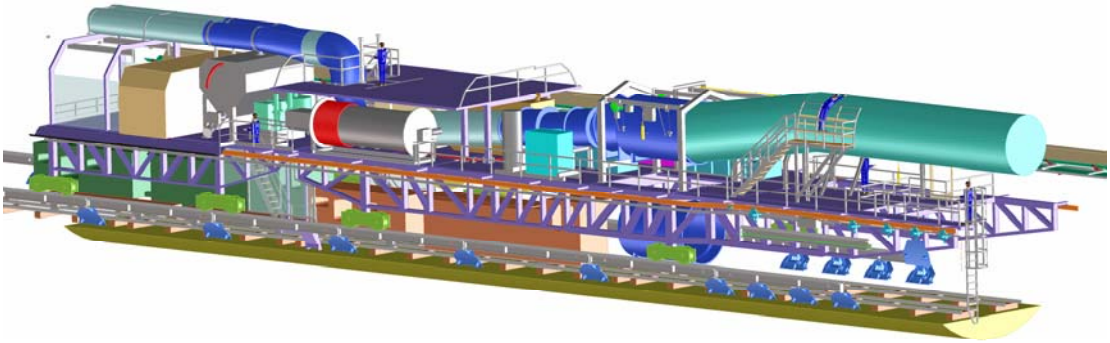
The headings are fed via a double rail.

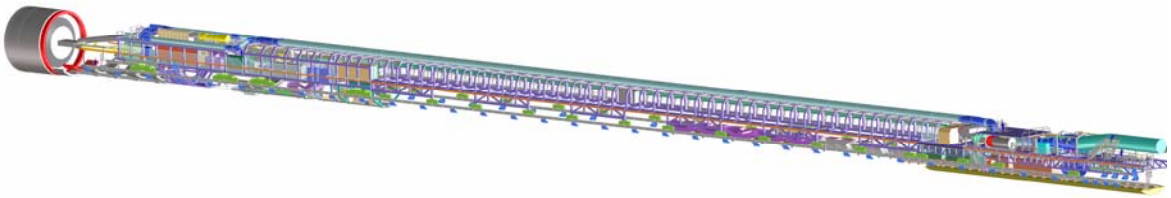
Various trains are transporting the following components to the back-up area:
- Lining segments
- Gravel for annular gap backfilling
- Sand and bonding agents for the annular gap mortar backfilling on the floor
- Continuous conveyor elements, conduits, supply for the headings

A continuous conveyor from the headings to the dump regulates the waste disposal of the muck.

Back-up 3 forms the rear end of the heading installation.
This part contains the infrastructure for the supply of
- Electrical energy
- Cooling and needed water
- Fresh air

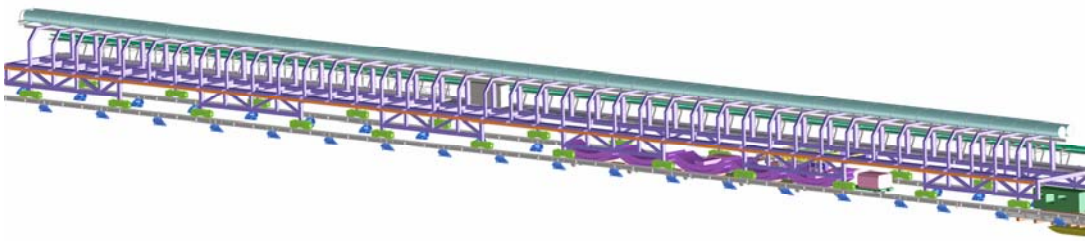
Furthermore, the NL 3 installation provides liberally for follow-up injections and continuous conveyor construction.

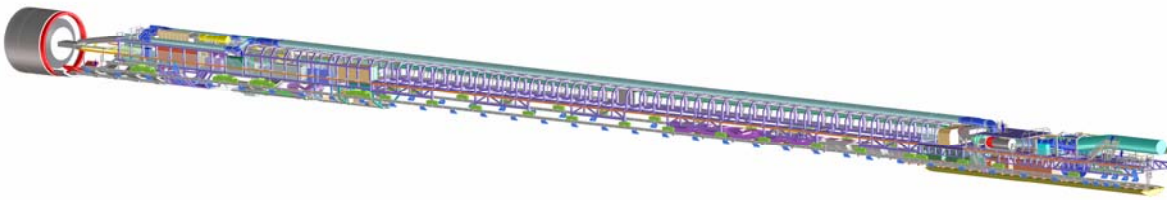




The NL 2 consists of the transloading station with double rail for the unloading of various trains and the floor installation area with the glider.

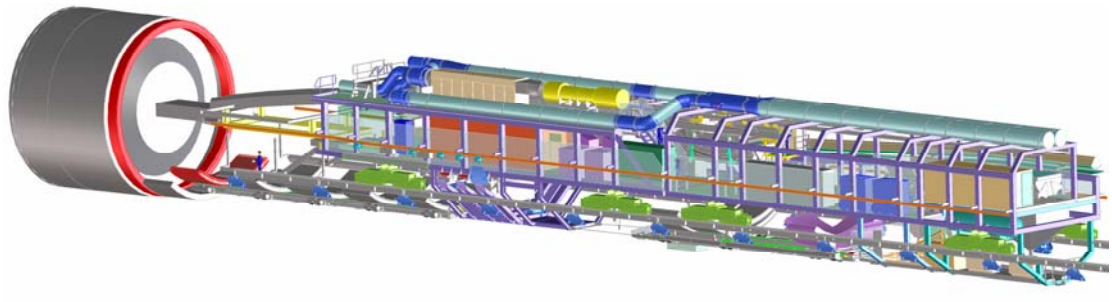
In the upper area, separate space is provided for the transport route of the heading supplies.

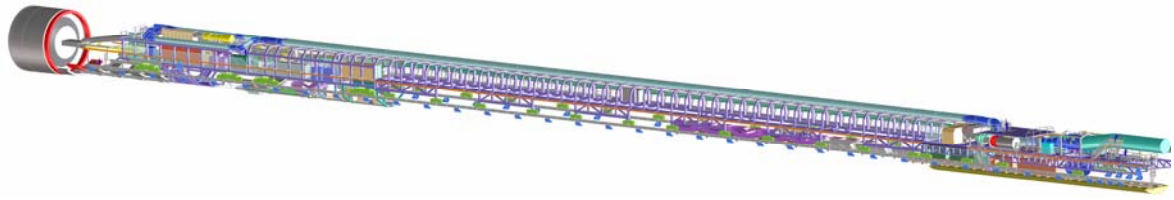




The intermediate storage and the installation area for the lining segments, the four components for the annular gap backfilling and the rail construction with the special consoles for the back-up are all placed in the back-up 1.

The infrastructure for the shield machine is installed on the middle deck.





5 Automation through specialized devices

Alltogether, we have automated three processes:

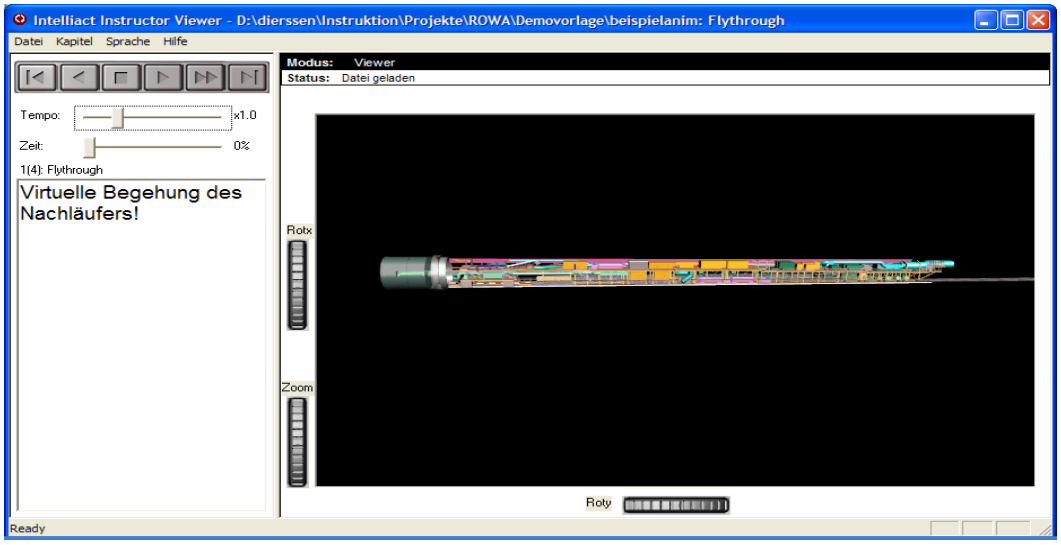
The lining segment transport from NL2 to NL1 over a distance of 180 m is automated.

The rail- and console transport from NL3 to NL1 over a distance of 225 m is automated.

The just in time production of wet mortar is automated on the back-up from the following three separated components:

- Sand earth-wet
- Adhesives open-dry
- water

The 3-D animation shows the automated lining segment transloading and the automated rail- and console transloading.



6 Productivity enhancement

The reduction of operating personnel is one result of automation.

Based on man-hour calculations, the following estimated reduction results:

Lining segment transport	1 man
Mortar mixing installation	ca. 0.5 man
Rail- and console transloading	ca. 0.5 man

Therefore, automation reduces manpower requirements by two persons in this area.

Calculated in hours, these are 2x8h per shift for 27m/AT, resulting in 16h/27m or a total of the considerable sum of 6'500h per installation for the entire heading duration.

Not included are the idle man-hours caused by heading stops or reduced operation.

Besides the reduction of personnel expenditures, automation offers further advantages: the possibility of operating mistakes is markedly reduced.

Subsequently, breakdowns of installation due to operating mistakes are also minimized, thus enabling a higher availability of the entire installation.

Should the automated operation eventually break down, an immediate switch to a manual operation is guaranteed.

7 Work place safety enhancement

I have mentioned at the beginning that work place safety is important. Well, also in this regard, the automation of the processes as we employ them in the Wienerwaldtunnel offers considerable advantages:

Within the automated area, personnel is no longer needed. This means the elimination of considerable potental dangers, in particular loading- and unloading the lining segments.

8 Importance of automation in the future

Ladies and gentlemen. After the industrialization, the might of mechanization turned into the might of automation. Allow me to mention here that this development is already well advanced in other industries and is catching up with us here and now. In our view, automation will have a great future in tunnel construction. In the Wienerwaldtunnel, we can prove that efforts in this direction are not without merit. Heading installation personnel are profiting from increased protection and the entrepreneurs from higher productivity.

We shall be successful with automation if the relevant work and personnel expenditures are rationally and uncompromisingly analyzed by both, the entrepreneur and the construction provider.

Basically, that means:
Many work-intensive tasks could potentially be automated.

To be concrete, the following jobs in the back-up area could be automated:

- Transloading of goods
- Segment lining handling
- Laying rails
- Transport and installation of gravel and mortar

- Supervision of processes
- Backfilling
- Mixing processes

With every project, it is worthwhile to define potential cost savings at an early stage and use them subsequently in the execution phase.

What would a potential cost savings solution look like?

In economical terms, the case is clear. For each investment, total costs have to be determined:

Investment + Operating Costs (incl. Personnel Costs) = Total Costs

The precise calculation of the total costs (investments and operating costs) is of high importance. As experience has shown, this requires a real effort and perseverence from responsible persons during the investment phase.

Big investments have to be made before construction begins, mostly under time pressure. It requires an extra effort and careful consideration at this stage to deal with the diverse cost-sequences all the way to the end of the project.

If the total costs are defined objectively, purchasing decisions can be made based on the lowest expected total costs, and not based on investment costs which are not crucial.

There is always the question of the profitability of an investment, in other words, the net value. For various reasons, one is rather cautious when dealing with this question. For example, who, during the offering phase, wants to question the stringently calculated production costs? Or, who is even willing to up-grade stringently calculated costs and, therefore, trigger a cost optimization through higher investments to gain higher productivity? There are enough positive examples of this in both, our company as well as yours.

We hope that we have been able to stimulate some thoughts about this very complex subject of investments in the construction area.

9 Closing comments

With the Wienerwaldtunnel project, we have realized new approaches in the automation of work sequences. This example illuminates how the potential to increase productivity and work place safety with TVM-headings can be explored and put to good use.

In the future, lets no longer talk about the difficulties but about the solutions!

Thank you for your attention.