TUNNEL RIEDBERG, A9, VALAIS - SWITZERLAND

Construction of the new Riedberg Tunnel (TURI), Valais, Switzerland

The Tunnel Riedberg is part of the A9 highway in upper Valais between Sierre and Brig.

Scope

- The approx. 550 m long Riedberg Tunnel consists of 2 tubes with two lanes each. In the middle, the tubes are connected by accessible cross passages.
- There are underground control centres in each portal areas (east and west).
- The tunnel is constructed with a double-shell lining with a partial waterproofing (umbrella).
- Soft-ground conventional excavation under the protection of a pipe umbrella with a short ring closure.

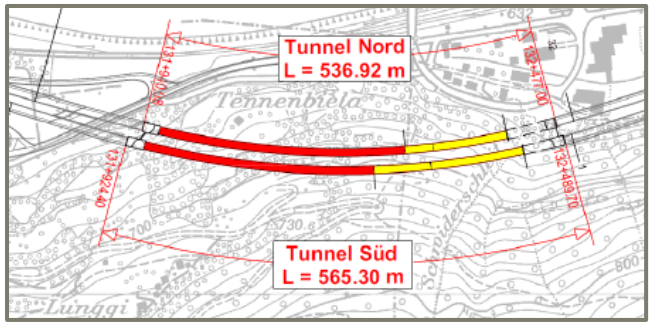
Challenges

- The Riedberg is a creeping slope. Excavation works began back in 2004, however were stopped again in 2005 due to increasing displacement rates of the slope. Excavation was only resumed in 2017. Monitoring the slope behaviour is therefore an essential part of the project.
- Due to the long duration of the project and interruptions of the excavation works, various support and reinforcement measures have been implemented. The completion of the tunnel must be planned compatible for all areas.

Amberg Services

- Overall project management realization of the project.
- Detailed design of tunnel, Site supervision during construction, commissioning
  (SIA-51, SIA-52 and SIA-53)

AMBERG ENGINEERING



- Situation status of resumption of tunnelling in 2017

- View Portal East

- View in the direction of the east portal, transition area from the rear area to the "resumption of excavation" area with in-situ concrete acting as a means of excavation support.

AMBERG FACTS

Contracted value Amberg

- Total Amberg CHF 2.8 Mio.

Project Phases & Duration

- Overall project management 2018 - 2022
- Expert planning Tunnel

Project details

Tunnel

- 2 tunnel tubes with a total length of approx. 550 m each, of which approx. 440 m conventionally excavated; average excavation cross section approx. 160 m^2
- 1 accessible cross passage, approx. 25 m^2
- Refurbishment previously excavated area. (heading years 2004 - 2005, length approx. 160 m)

Portal areas

- Cut-and-cover / portal structures, length east approx. 60 m, Length west approx. 30 m
- Antirecirculation walls, retention basins, technical centres and road underpasses for maintenance

Slope displacements

- Monitoring concept during construction and operational phase
- Assessment of overall slope stability and evaluation of displacement behaviour

CLIENT FACTS

Overall costs

- Total amount approx. CHF 200 Mio.

Overview project

- The Tunnel Riedberg is a section of the A9 highway in the Upper Valais as part of the network completion with a total length of 31.8 km, of which 15.8 km
  (approx. 50 % tunnels and cut-and-cover).
- At Gampel-Steg station, the A9 highway passes underground through the foot of the Riedberg. The length of the Riedberg tunnel is about 550 m.
- Excavation driven forward from the east portal. Near the west portal, the adjoining Tennen bridge has already been constructed.
- Excavation works began in November 2004 and were stopped in June 2005 due to increased slope deformations.
- After comprehensive investigations of the slope stability and reinforcement measures, a new detailed project was developed and excavation resumed in June 2017.

Geology

- Top layer and block-rich slope debris with a smooth transition to interglacial landslide material
- Creeping slope with variable movement rates, depending on surrounding influences
- Variable mountain water, expected increase due to springs around the west portal

Contact Person

Predrag Stefanovic
Overall project manager ANSB
Office for National Road Construction,
Glis VS, Switzerland
Tel.: +41 27 606 97 00
eMail: predrag.stefanovic@admin.vs.ch

AMBERG ENGINEERING

CHALLENGES

Bracing formwork of load-bearing excavation support

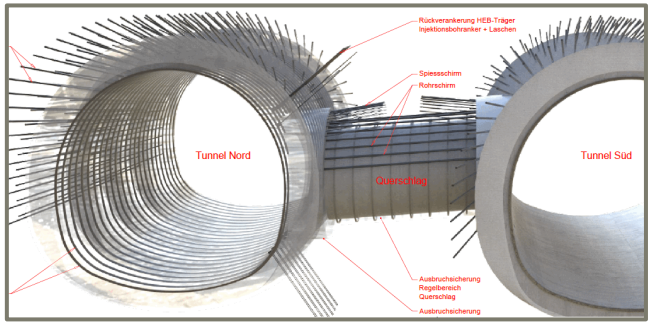
Heading / Optimizations / slope creep

Excavation and Excavation support
- Soft ground tunnelling with large cross section
- Local excavation face instabilities
- Dimensions at the limit for the equipment used

Optimizations
- Review existing project of the previous project designer.
- Identification of optimization potential for tunnelling work
- Identification of optimization potential for the currently pending project design, e.g. for the reinforcement of the rear area of the tunnel.

Slope creep, long-term displacements
- Long term slope creep
- Differential displacement rates
- Various constraint points along the tunnel, e.g. the existing Tennen bridge in the west portal area and the required clearance gauge.

ENGINEERING APPROACH



Modelling of tunnel tubes incl. cross adit

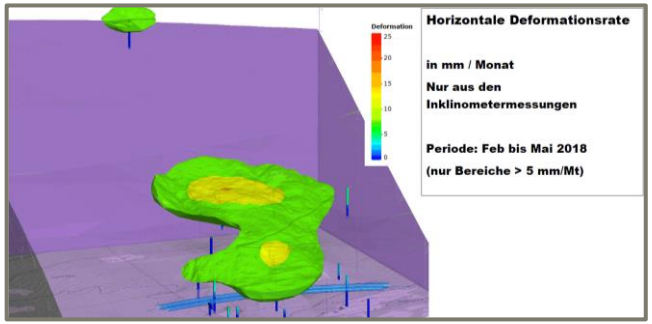
Driving / Optimizations / Slope creep

Excavation and Excavation support
- Structural review of the existing excavation and support concept
- Analysis of work cycle and compilation of alternatives

Optimizations
- Cross-section survey (scan) of the previously constructed area of tunnel
- Comparison of target and actual profile and changes compared to previous scans
- Verification of the structural design under consideration of the improved soil properties due to previous improvements implemented during the interruption of the tunnelling excavation (radial jetting)

Slope creep, long-term displacements
- Evaluation of the monitoring data available so far
- Establishment of a monitoring concept for the long-term monitoring of the slope and relevant objects, considering current monitoring methods and new technologies
- Prognosis / scenarios of the expected displacements long-term slope creep

TECHNICAL SOLUTIONS



Representation of the deformation rates Riedberg

Driving / Optimizations / Slope creep

Excavation and Excavation support
- Subdivision of the cross passage into partial excavation windows.
- Reducing length of an advance
- Reduce spacing between face anchors
- Incremental installation of excavation support

Optimizations
- Optimization of the excavation under consideration of the structurally necessary permanent lining.
- Concept for a possible shift of alignment to compensate for slope shifts during the construction phase
- Ensure work safety during break out of existing tunnel support, by defining clear working cycles.

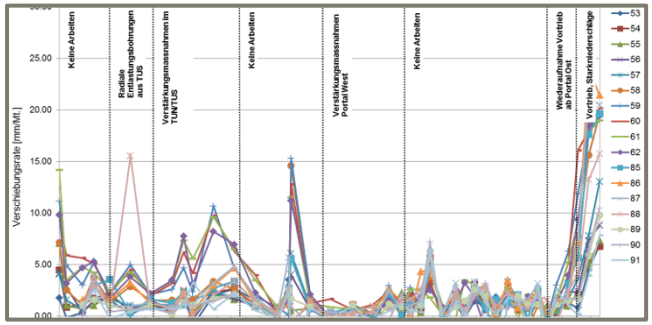
Slope creep, long-term displacements
- Optimization of the alignment
- Maximisation of tolerances in the existing tunnel profile for corrections in the operating phase
- Design of the inner arch permanent lining considering the forces from the displacement and for any differential loads to ensure load-bearing capacity and serviceability.

AMBERG ENGINEERING

CHALLENGES

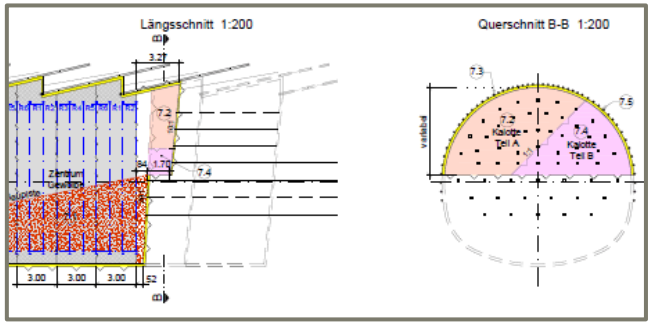
- Full Face Excavation, local instabilities

- Optimisation refurbishment of previously constructed tunnel

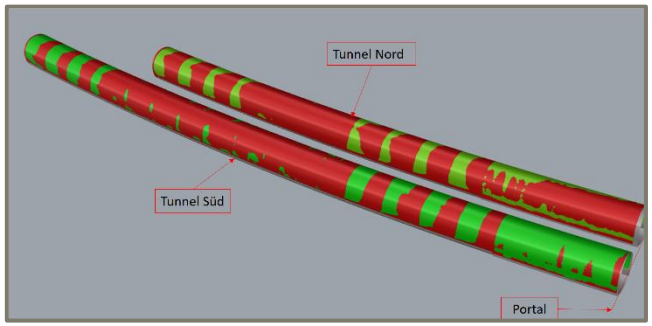


- Long term displacements of the slope / tunnel

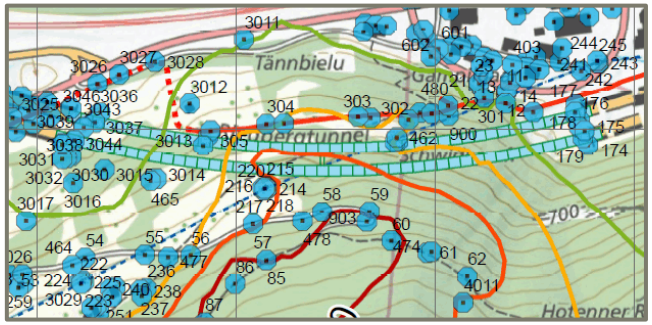
ENGINEERING APPROACH



- Analysis of previous project, work cycle



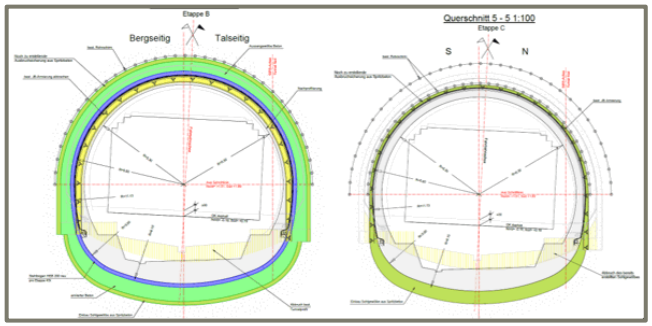
- Evaluations Scan, target/actual comparison



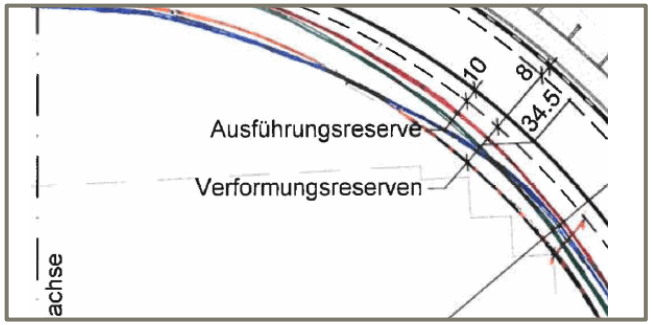
- Development of a monitoring concept, evaluation and prognosis of the displacements

TECHNICAL SOLUTIONS

- Excavation with partial excavation windows



- Optimization of required excavation cross section



- Maximisation of tolerances in the final lining profile for corrections in the operating phase

AMBERG ENGINEERING

AMBERG KEY PEOPLE INVOLVED

Gerd Wieland
Civil engineer
Project Manager Tunnel Design
Deputy overall project manager

gwieland@amberg.ch

Jasmin Amberg
MSc in Civil Engineering
Deputy project manager for tunnel design

jamberg@amberg.ch

Dieter Wenner
Dipl. Geologist
Subproject manager surveying / monitoring / total slope stability

dwenner@amberg.ch

Jean-Pierre Hürzeler
Dipl. Geologist
Subproject manager geology

jhuerzeler@amberg.ch

AMBERG TEAM @ WORK

AMBERG SPECIALIST' TESTIMONY

“ The design of the Tunnel Riedberg is very demanding due to the complex geotechnical situation with long-term differential displacements. The long project duration since the original start of construction in 2004 with many different project participants and documentation places great demands on the project management. Amberg Engineering is confident that this demanding project will continue to be carried out to the complete satisfaction of the customer. ”

Gerd Wieland
Project Manager Tunnel Planning

AMBERG ENGINEERING