New TWIN-TRACK BÖZBERGTUNNEL



New twin-track tunnel, Schinznach-Dorf upto Effingen, Switzerland

New twin-track tunnel as part of the 4m corridor project Basel – Chiasso / Ranzo on the Gotthard axis. Conversion of the old, excisting tunnel to the safety tunnel.

Scope

- Total length approx. 2.7km
- Cut-and-cover section (2 pcs.), approx. 45m
- Soft-ground section approx. 170m
- Two portal structures und entry-cut
- TBM drive rock, on 2.5km length, excavated crosssection 12.36m
- Cross-connections (5 pcs), approx. 40m
- Conversion of old, existing tunnel to the safety and rescue tunnel, length approx. 2.5km

Challenges

- Loose rock drive with minimal overlap
- Difficult geological conditions in the border area of the Tafeljura und Faltenjura
- Traversing thermal protected zone Bad Schinznach
- Sulphate rocks and clay rocks with high spring potential

Amberg Services

- Amberg Engineering is in charge of the engineering association JV BözbergPlus, which has been commissioned by general contractor Implenia Schweiz AG for executive design (phase 51 / 53)
- Overall project management IG *BözbergPlus*
- Executive design for the subprojects loose rock excavation, cross connections and cladding





Location of the Bözberg Tunnel



Location of the old and new Bözberg Tunnel

AMBERG FACTS

Contracted value JV

Total CHF 4.7 Mio.

Contracted value Amberg

ca.CHF 700'000

Project phases & duration

- Final design
- Execution
- Conversion old Bözberg Tunnel

Project details

Pre-cut and soft-ground drive

- On the side Schinznach-Dorf and the side Effingen a driven portal to cut-and-cover section with 37m and 45m length joins on.
- The south portal results in the weathered Keuper a loose rock section of about 170m, driven up in the crown-heading in the shelter of a pipe screen.

Drive rock section

- Shield maschine TBM, drive length 2'516m, Excavated cross-section 12.36m
- Double-shell lining with segment support and insitu-lining
- Sealing in the area of the thermal protected zone with pressure-retaining full seal

Conversion of old, existing tunnel in service and rescue tunnel

- Dismantling of the railway technical equipment
- Roadway installation for road vehicles
- Refurbishment of the old tunnel and connection to the new tunnel with 5 cross-connections
- Installation lighting and overpressure ventilation and locks on the portals

CLIENT FACTS

Overall costs TP21

CHF 180 Mio.

Overview project

- The existing Bözberg Tunnel was built by the Swiss North-East-Railways in the years 1871 – 1875.
- The existing railway tunnel is located on the feed line to the Gotthard Base tunnel, but its dimensions do not meet the minimum requirements (corner height 4m) of the combined transport.
- The mandate includes the planning of the new tunnel including the link with the existing track, as well as the conversion of the existing old tunnel into a service- and rescue tunnel.

Geology

since 2015

2016 - 2020

2020 - 2022

- The Bözberg Tunnel lies in the boarder area of Tafeljura (north) and Faltenjura (south). The tunnel goes through the Jura's overthrust, a shear zone up to 100m thick with multiple, often branching shear planes.
- On rocks, limestones, limestone marls, dolomites, clay stones and sulphate-containing rocks (anhydrite) are possible. The latter are known for their high swelling potential.

Contact person

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CHALLENGES



Soft-ground drive in weathered Keuper-layers

Complex geological conditions

- Loose rock excavation with low overlap and cohesive material
- Heterogeneous soil conditions in the loose rock section
- Traversing thermal protected zone Bad Schinznach
- Traversing rocks with high swelling potentional (anhydrite, Opalinus clay, marl)
- High swelling pressures in areas with low coverage in loose rock
- High fire-safety requirements
- Complex geometry in cross-section and in interfaces to other lots

ENGINEERING APPROACH



BIM model soft-ground section

Innovative approach

- Analysis of the relevant hazard pictures and design of the support means with FE-models
- Creation of geology BIM models for coordination between contractor, client and PV
- Planning of a gentle TBM-excavation and a pressure-retaining full seal
- Dimensioning of the segments and facing for swelling pressures of up to 2.4MPa
- Planning a monolithic construction and design using 3D shell models
- Hot rating for the fire curves HCinc and ISO-834 and fire-tests
- Creation of 3D models for visualization and coordination purposes

TECHNICAL SOLUTIONS



Finished tunnel tube after the excavation

Robust solutions

- Crown heading under cover of a pipe arch and excavation face support with anchor
- 2-shell lining with a 2-lining FPO sealing (can be testet and injected)
- Application of the resistance princible and use of a height-adjustable fixed track (LVT-System)
- Monolithic connection of inner shell blocks through continuous screw reinforcement
- Use of PP fibre in the facing concrete to improve the spaling behavior



KEY PEOPLE INVOLED



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AMBERG TEAM @ WORK



