

NEW ALBULA TUNNEL II

Albula Tunnel Line Chur – St. Moritz, Preda

Albula New Tunnel Project

The Albula Tunnel is a single track narrow gauge railway tunnel running between Chur and St. Moritz, crossing the Albula Pass (2'312 m).

Scope

- After the tunnel inspection in the year 2006 the refurbishment of several areas of the existing tunnel (5'865 m) and safety improvement were decided
- The final decision was to build a new tunnel parallel to the existing one
- After refurbishment of the old tunnel it will be used as an emergency escape tunnel
- Both tunnels will be connected by cross-passages approx. every 450 m
- The new tunnel will have a single- shell shotcrete lining, with double-shell lining near portal areas
- Length of new tunnel will be 5'855 m

Challenges

- Difficult geological conditions and water inflow at portal areas. Greywacke formation of 100 m thickness with "swimming mountain"
- Mountainous climatic conditions at 1'800 m a.sl. , cramped conditions at installation areas, complex logistic conditions
- Conservation of environment and heritage, ensuring max. work safety at the same time

Amberg Services

- Overall project management
- Progress, cost and quality control



■ Portal of old tunnel behind arched stone bridge



■ Old tunnel, after passing soft ground area



■ Old tunnel, deteriorated sections and brick lining

AMBERG FACTS

Contracted value JV

- Total JV: 6.5 Mio. CHF

Contracted value Amberg

- Total Amberg: 6 Mio. CHF

Project Phases & Duration

- Planning phase Nov. 2010
- Constructionphase since 2014
- Project completion 2020 / 2022

Project Details

Construction of the new tunnel

- Narrow gauge single track tunnel
- Cross-section 40 m²
- Double shell lining in portal area and in wet areas
- Single shell lining for the remaining tunnel
- Fixed carriageway and power rail catenary

Refurbishment of the old tunnel

- Refurbishment of the old tunnel in accordance to new safety requirements
- Securing of the tunnel using shotcrete, mortar and anchoring for the desired new safety functionality

Cross-sections, niches and safety measures

- Cross passages at 435 – 456 m intervals between new tunnel and old tunnel (safety tunnel)
- Technical infrastructure in separate rooms within the cross passages
- Ventilation of safety tunnel with overpressure

CLIENT FACTS

Overall costs

- Total: 359 Mio. CHF

Overview Project

The Albula Tunnel is a single-track narrow-gauge railway tunnel running between Chur and St. Moritz / Tirano (I).

During an inspection in 2006, severe damages were discovered in several areas of the existing tunnel, with the urgency of a refurbishment in up-coming years. Additionally, the tunnel was not meeting the modern requirements for either the clearance envelope (load gauge) nor for safety.

For these reasons, a new single-track tunnel will be built parallel to the existing one. The old tunnel will be used as safety tunnel.

Geology

- Soft ground and brittle rock (0.3 km)
- Allgäuer schist (1.1 km)
- Rauwacke dolomite section (100 m)
- Albula Granite (4.4 km)

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CHALLENGES

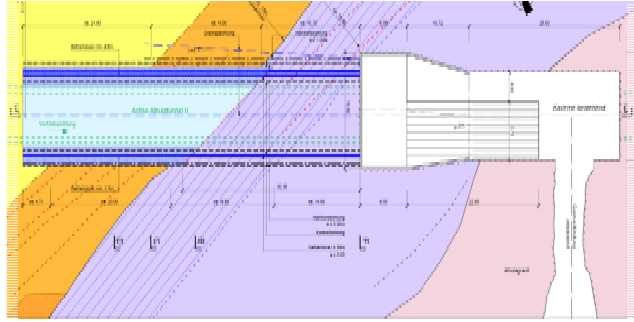


Deteriorated area at the vault section of old tunnel

Greywacke zone as construction challenge

- Approximately 100 m thick Greywacke formation at Tm 1'150
- Section I and Section II including fractures zones and poor rock quality, additionally heavy water ingress
- Section III with Greywacke and „swimming mountain“, 110 years before multiple collapses of the tunnel in this section. Approximately 1 year construction time for the Greywacke formation was needed

ENGINEERING APPROACH



Situation at the freezing test cavern

Determination of construction method with fall back solutions

- Development of concept for the construction of the sealing body
- Development of auxiliary construction measures
- Assessment of measures with respect to feasibility, drainage efficiency and cost
- Determination of work flow concept with fall back solutions for the sections I to III
- Establishment of an exploration cavern in context with a separate lot of the preliminary works
- Conduction of exploration boreholes
- Injection tests (laboratory)
- Freeze / thaw trials (laboratory)
- Involvement of experts

TECHNICAL SOLUTIONS



Freezing tubes at cavern at Tm 1'300

Freezing “Swimming Mountain”, Section III Rauwacke Formation

- Development of heading concept for sections I and II using injections
- Working out of the freezing project for section III
- Conduction of freezing works at section III independent of construction lot by a specialized company
- Excavation starting from cavern and installation of sealing as well as inner lining as counter advance to avoid any time dependence with the heading in the main tunnel.

CHALLENGES

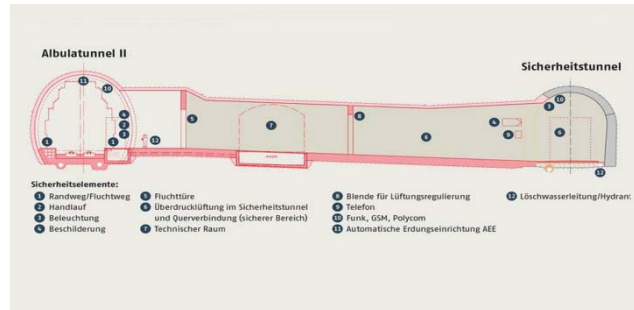


Situation showing location of old and new tunnel

New tunnel instead of refurbishment

- Existing tunnel shows damages, which needed to be refurbished in up-coming years
- Clearance gauges were extremely narrow and did in most cases not provide the necessary space for reinforcements
- The safety did not meet the current requirements
- The existing tunnel is part of the UNESCO world heritage of the Albula and Bernina railway line
- Variant study refurbishment vs new tunnel building
- Consensus with federal authorities for the solution to build a new tunnel on the basis of a detailed variant comparison

ENGINEERING APPROACH



Safety concept using cross-passages & old tunnel

Tunnel System for Maximum Security

- The solution with the new tunnel allows the re-use of the existing railway tunnel as safety tunnel in respect of the passenger self-rescuing
- The new tunnel can be connected to the safety tunnel by cross-passages
- Escape routes lead directly to the cross-passages and into the safety tunnel, which can be over pressured by the ventilation in case of emergency
- The new tunnel shows a very high level of security, which complies fully with the nowadays safety requirements
- Determination of the intervals between the escape exits by means of a quantitative risk analysis including an escape situation simulation
- Investigation of a ventilation concept (including ventilation measurements in the existing old Albula tunnel) led to the result, that a separate ventilation in the new tunnel was not necessary

TECHNICAL SOLUTIONS



Escape door (sliding door) to the secure area

Save Escape Route from the New Tunnel

- Escape route is equipped with a fire safe sliding door
- Behind the sliding door air over pressure is prevailing, this avoids any ingress of fumes
- Technical rooms are located in the area of the cross-passages, which also contain the technical infrastructure as well as the safety equipment
- At the portal areas are installed locks with additional integrated ventilators for the negative pressure ventilation (suction)
- The safety tunnel provides the clearance for the access of the rescue teams, especially fire fighters, but also for operation and maintenance
- The safety tunnel contains a continuous extinguishing water pipe with taps at the cross-passages
- The escape route is signaled and secured by an illuminated handrail, illuminated escape exits and illumination in the safety tunnel itself.

CHALLENGES



■ Site installation Preda, belts, bags with greywacke



■ Construction site of new Albula



■ Complex logistics, loading on narrow gauge

ENGINEERING APPROACH



■ Portal of new tunnel at Preda



■ Securing of the new portal area



■ Merge between the old and the new tunnel

TECHNICAL SOLUTIONS



■ Shotcrete reinforcement for excavation new tunnel



■ Technical equipment in cross-passages



■ Albula, UNESCO world heritage

AMBERG KEY PEOPLE INVOLVED



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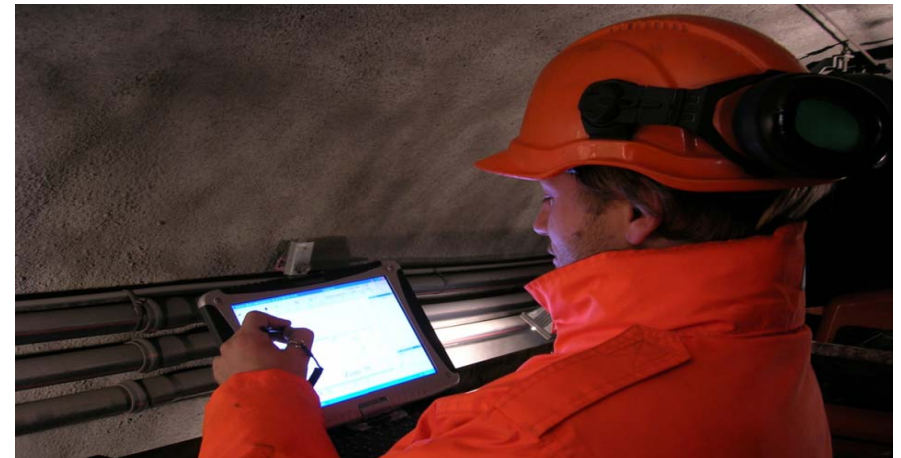
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AMBERG TEAM @ WORK



Investigation and assessment of old tunnel