General renovation, escape and safety passageways via the supply air duct at the “Arlberg Road Tunnel”

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Agenda

- Project Overview
- Project Preparation
- Realization
  - Building Phase I – traffic stops during night
  - Building Phase II – full closure 2015
  - Remaining building phases until 2017
- Conclusion
Project Overview
The Arlberg Road Tunnel

- longest road tunnel in Austria
  - almost 14 kilometers
  - opened for traffic in 1977
- only all-year-passable connection between Tyrol and Vorarlberg
- part of the trans-European road network
  - recently 8,000 vehicles pass daily
  - in 2025 more than 9,500 will be expected
The Arlberg Road Tunnel

- General renovation
  - due to Vehicular Tunnel Safety Law (STSG) until 2019
  - operated as an oncoming traffic tunnel because of traffic forecasts
  - investment volume of 160 million euros
  - after general renovation, the Arlberg Road tunnel will be the safest of its sort
General Renovation 2014 - 2017

- **Existing**
  - 16 emergency bays on the south side wall
  - 7 escape tunnels between railroad and road tunnel (since 2007)

- **New**
  - 37 escape tunnels (semi-circular staircases to supply air duct)
  - 8 emergency bays on the north side
  - 3 operating tunnels for medium-high-voltage, transformers etc.
  - renewal of dewatering and extinguish water systems
  - new equipment (thermal scanners, spray mist installation etc.)
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General Renovation 2014 - 2017

Asfinag (2013)
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General Renovation 2014 - 2017

Asfinag (2013)
Project Preparation
Project Preparation

- start of planning in 2010
- Feasibility studies
  - construction besides traffic
  - construction of a second tube tunnel
- Results
  - guarantee safe and drivable route in winter
  - complete closing of tunnel only during summer months
  - several building phases with 2 complete closings (May to November, 2015 & 2017)
  - broad information campaign for all stakeholders
Project Preparation

- Tendering Model of the client (ASFINAG)
  - General contractor model - including detailed design
  - due to complex connections between structural and electro-technical requirements

- „Kreatives Bauen am Bestand“ – „Building Model Innovation“
  - developed in cooperation with the „VIBÖ“
  - Arlberg Road Tunnel project became a pilot
  - allows the contractor to make optimizations after commissioning
  - As an additional incentive a monetary bonus for savings is fixed
Realization
Organizational structure

client

general contractor

sub-contractor

Construction

Electro-technical
Planning and optimization process

- Started in June 2014 with the commissioning
- Essential optimized components
  - Video supervision
  - Stainless steel construction
  - Building process in emergency bays
- Innovative solutions led to
  - cost reduction
  - increased customer benefit
Building Phase I

- Phase I in winter months from November, 2014 to April, 2015
- Alternating traffic stops during the night (8 pm to 5 am)
- Challenges in this phase
  - Works besides traffic
  - Daily safety equipment installation at site
  - Transportation logistics
Building Phase I - Shotcrete concept

- “Schretter Halbnass” System
  - transporter with filling capacity of 6 – 10 cbm (dry shotcrete)
  - filled with silo trucks (dust free, less transportations)
  - pre-moistening up to 60% of total added water
Building Phase I - construction Works

- 9 rescue tunnels (37 in total)
  - 500 meters excavation
  - cross section of 15 m²
- over 4,500 new high-grade steel hanging bars
- preparation works for full closure:
  - cutting works in concrete shell and lanes
  - anchoring in areas of new emergency bays
Building Phase II – full closure

- With beginning of full closure on April 21st, 2015, the main phase of construction started
- over 1,500 building sites have to be completed in 6 months
- over 2,300 meters of drill and blast excavations
  - 28 walkable rescue tunnels (15 m²)
  - 3 drivable operating tunnels for energy installations
- 8 new emergency bays
- more than 200 new fire extinguishing and dewatering niches
- over 17 kilometers of fire extinguishing water supply, sewage pipes and sidewalks
- with start of phase II number of workmen quadrupled to over 650 in action
Building Phase II – rescue tunnels

- Excavation works for 28 rescue tunnels within 4 months
  - so called „Rottenbetrieb“ – a workmanship is concerned for 2 – 3 tunnels simultaneously by using one machinery-set
  - up to 9 tunnels are driven up by 3 workmanships at the same time

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ASAB (2015)
Building Phase II – energy stations

- Excavation works for 3 energy stations
  - time critical with new emergency bays and electro-technical equipment works
  - started at beginning of full closure

- Interior finish
  - reinforced base plate
  - tunnel sealing
  - reinforced shotcrete for the lining
New emergency bays (optimized)
New emergency bays (optimized)
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New ventilation niches (3x36m)  New rescue tunnel
Remaining building phases until 2017

- End of total closure in mid-November 2015
- followed by construction phases with night works
  - new tunnel coating on side walls
  - final construction works in rescue tunnels
  - major installations of electro-technical equipment
- 2nd total closure from April, 2017 to September, 2017
  - final construction works
  - integration and re-operation of all components
  - approval for traffic in the end of September, 2017
Conclusion
Tunneling under challenging conditions

- **Major challenges**
  - construction works under traffic during the night
  - followed by an enormous personnel placement and machinery use
  - the allocation and coordination of more than 600 workmen to 1,500 sites
  - fluent logistic process
  - compliance of safety demands in a 14 kilometers single-tube tunnel
  - accommodation and transportation of all the stuff

- **Success factors**
  - professional preparation with optimisations made in advance
  - cooperation of all stakeholders
Thank you for your attention