TUNNEL GUBRIST, 3RD TUBE

New construction 3rd tube Tunnel Gubrist, Zurich, Switzerland

The construction of the 3rd tube Tunnel Gubrist is the centrepiece of the expansion of the northern bypass in Zurich.

Scope

- The new construction of the 3rd tube Tunnel Gubrist has a total length of 3.3km. Of these, 3'010m will be created as a mining tunnel and about 300m as a cut-and-cover tunnel
- On the side Weiningen joins the portal to a 100m long overlap
- The tunnel is connected to the existing second tube with 12 cross-sections (accessible and passable)
- The lining is double-shell with drained partial seal (umbrella seal)
- 3 operating centers are planned, one of which will be built underground around the lay-by
- 2 central ventilation units with smoke exhaust system at the portals Affoltern and Weiningen
- The execution is carried out by blast heading

Amberg Services

- SIA project phases 32 to 53 (Preliminary design to commissioning)
- Overall responsible project manager, project manager of sub-projects and site supervision
- Planning & Design of all underground structures
- Within JV, planning & design and coordination of the sub-projects tunnel, cut-and-cover / construction pit, installation sites / loading bay, Cover Weiningen.
- Application of departments of the Federal Roads Office ASTRA: tunnel/geotechnics, engineering structure, alignment/environment, operating and safety equipment/installations
- Ventilation Design, Geology from tender design
- Coordination of interfaces with adjacent subprojects (lots 1,3,4)
- Coordination with further consultants (Fit-out, Environment, Traffic, Architects)
- Coordination with Operations, city and canton of Zurich, municipalities, AXPO and SBB

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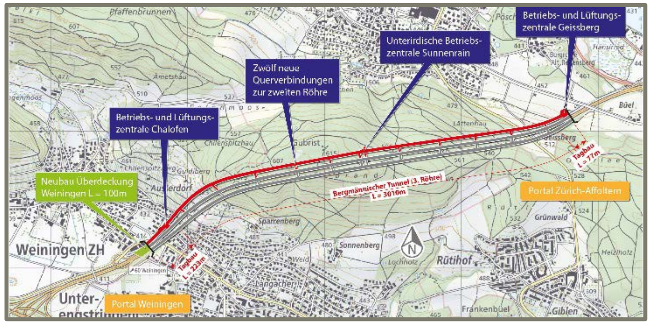
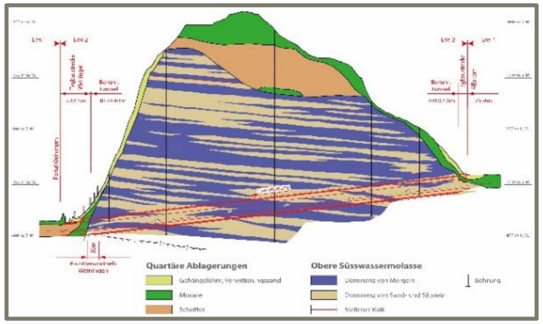
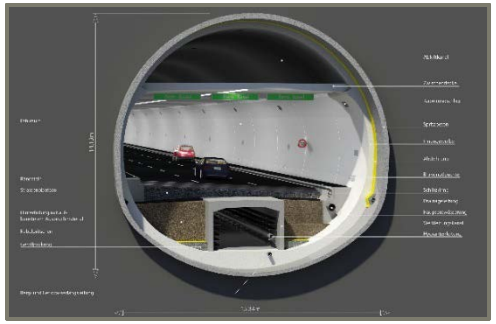


- Situation 3rd tube



- Geological longitudinal section



- Normal profile blast heading (178m²)

AMBERG FACTS

Contracted value JV
- CHF 16.7 Mio.

Contracted value Amberg
- CHF 10 Mio.

Project phases & Duration
- Project planning & design — since 2005
- Execution of the project — 2016 – 2022

Project details
- 3km mined tunnel,
  Horseshoe with rounded invert cross-section width 15.34m, height 14.48m.
  excavated cross-section 178m²
- Cut-and-cover tunnel Affoltern (l = 77m)
- Cut-and-cover tunnel Weiningen (l = 223m + 100m)
- Operating and ventilation centres at the portals
- 4 vehicle accessible cross-passage (40m²) with access to the service tunnel
- 8 person-accessible cross-passages (15m²)
- 1 cross-passage on service tunnel level
- 26 SOS- and hydrant niches (mined)
- Underground operations centre (5'000m³)
- 62m long landing bay with impact protection
- Extinguishing water supply with connection to existing system
- Separation system for mountain, meteor and wastewater
- Deep excavations at both portals (153'000m³ fixed)
- Cut & Cover method
- Muck removal railway station for 600'000 solid-m³
- Site installation areas in Affoltern and Weiningen
- Utility relocation works
  (natural gas, 110 kV overhead line, etc.)
- Three-lane auxiliary bridge in Affoltern as a temporary replacement of a key road and measures for traffic diversion

CLIENT FACTS

Overall costs
- Total CHF 565 Mio. (base: April 2006)

Project overview
- The construction of the new 3rd tube Tunnel Gubrist has a total length of 3.3km. Ca. 3'000m mined and ca. 300m as a cut-and-cover.
- On the side of Weiningen a 100m cover slab connects to the portal structure
- The new tunnel is connected to the existing 2nd tube by 12 no. accessible cross passages (vehicle and person accessible)
- The lining is a double shell with umbrella water proofing membrane (drained)
- 3 operating centers, one constructed underground.
- 2 ventilation centres with smoke exhaust structures at the portals Affoltern and Weiningen
- Excavation by means of drill & blast

Geology
- Upper freshwater molasse (alternating storage of sand / siltstone and marl), horizontal stratification
- The two entry cuts are partly in the molasse and are covered with soft-ground layers, which consist on the valley sides of moraines and gravel as well as from hang deposits
- Low mountain water resources
- In the area of the mining tunnel, the coverage varies between 8m and 200m. The height difference between both portals is about 40m

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CHALLENGES

- Up to and including tender design (SIA 32-41) the project is planned & designed with the TBM-S excavation method (Ø15.7m) with segmental lining, conventional excavation with drill & blast and a machine-assisted excavation with pilot tunnel (Ø5.0m)
- The tunnel lining consists of an outer steel fibre sprayed concrete lining, rock bolts, umbrella waterproofing membrane and an unreinforced in-situ concrete secondary lining
- Planning & Design services are carried out in compliance with current standards, safety standards and ASTRA specifications regarding operation and safety
- Application of the ASTRA areas of tunnel/geology, tunnel/environment and engineering structures
- Project in focus of the public, politics and environmental organizations
- Construction under operation (the two neighbouring tunnels remain in operation during the entire construction period)
- Extensive traffic planning
- Portal Weiningen in the middle of a residential area.
- Considerations of vibrations, noise and structure-borne noise around the existing facility and in the residential area
- Integration of noise protection measures at the portals
- Complex construction site logistics and stringent requirements on material management (railbound muck handling facility)
- Extensive earthworks and concrete work
- The development of the northern bypass carried out in vicinity of moor biotopes
- Conducting drill & blast trials
- Evaluation of swelling tests (marl)
- Modelling execution design in 3D (BIM)

ENGINEERING APPROACH

Driven portal side Affoltern

Main drive Affoltern

- The main excavation face of the mined tunnel is commenced from Affoltern
- The excavation is carried out with a heading advance, followed with bench and invert.
- Drill & Blast excavation method
- Machine-aided excavation in rock

Dismantling bench using a rock cutter

TECHNICAL SOLUTIONS

Driver portal side Weiningen

Support measures

- The tunnel advance of the mined tunnel in Weinigen heads into the opposite direction challenged with low overburden.
- In order to minimize settlement in the urbanised area, five (5) pipe umbrella advances (l= 15m) with subsequent spiles (l= 30m) were constructed.

Installation pipe screen

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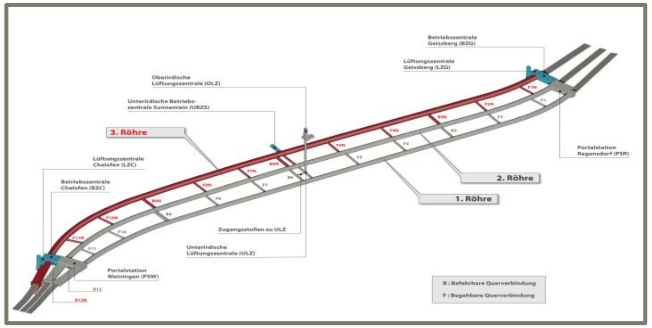
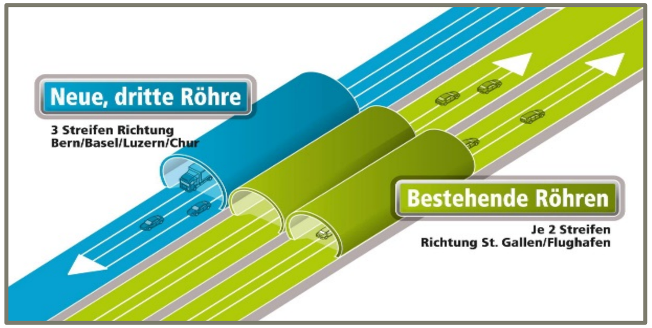
CHALLENGES



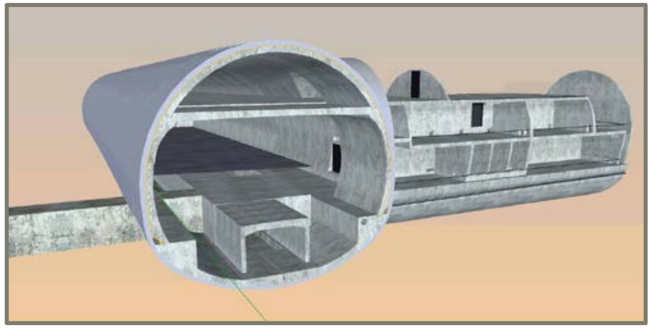
- Modelled situation



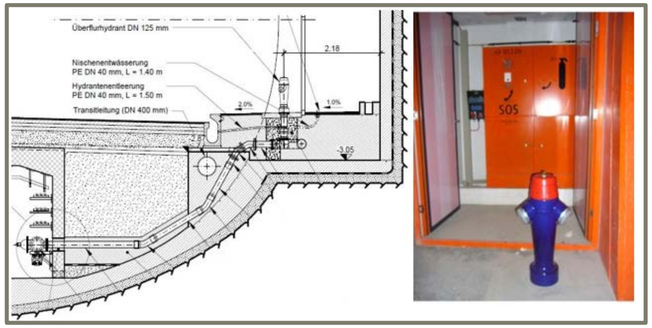
- New traffic regime

- Execution lid construction Weiningen

ENGINEERING APPROACH



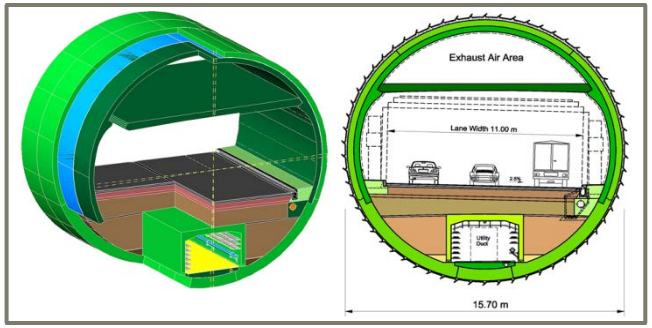
- Underground operations centre, 3D model (BIM)



- Combined SOS and hydrant niches

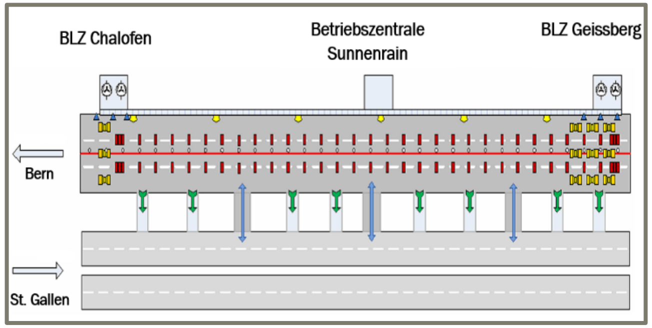
- Loading station, material management

TECHNICAL SOLUTIONS



- Normal profile (TBM-drive)

- Service tunnel elements (WLK)



- Overview of operating and ventilation centres

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