ALBORZ TUNNEL

Alborz Tunnel, Tehran Shomal Freeway, Iran

Project Alborz Service Tunnel.
The service tunnel is part of the two Alborz main tunnels of the Tehran Shomal Freeway. The service tunnel serves also as an exploration gallery for the complex geology and a water drainage path.

Scope

- Service tunnel for road tunnels
- Length 6.1 km
- For exploration purposes, water drainage and ventilation
- Basic design for Road tunnel with 2 two-lane tubes
- Length each 6.1 km

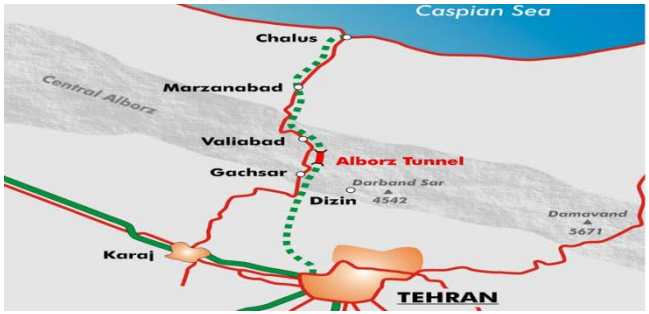
Challenges

- Altitude of project 2’400 m
- Squeezing rock
- Several fault zones leading to considerable over break and cutter head jamming
- Significant water ingress
- Methane gas in high concentrations
- Presence of H2S gas

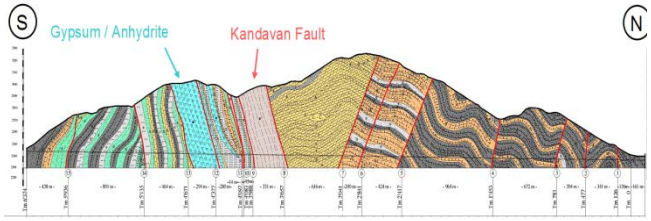
Amberg Services

- Construction supervision
- Consulting services in project management
- Design and design management
- Geotechnical services and consulting
- Detailed design of standard cross-sections for machine drive

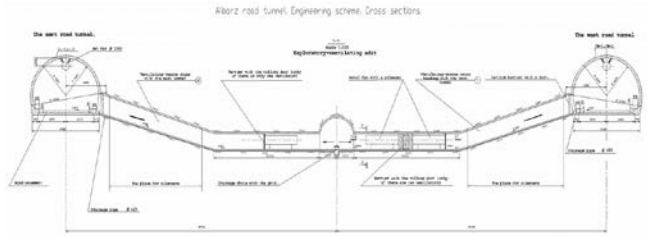
AMBERG ENGINEERING



- Map with Shomal highway and Alborz tunnel



- Geological profile of Alborz tunnel



- Cross-section of the service and main tunnels

AMBERG FACTS

Contracted value Amberg

Total	3.74 Mio €
Total Main tunnel basic design	0.14 Mio €

Project Phases & Duration

Planning & design phase	2002 – 2009
TBM excavating	start 2005
Break through at south portal	Feb. 2009
Construction works	2003 – 2009
Basic design Main Tunnels	2010 – 2011

Project Details

Service tunnel

- Open gripper TBM
- Diameter 5.2 m
- Single shell lining with shotcrete, rock bolts, meshes and arches reinforcement

Main road traffic tunnels (not scope of this contract)

- Drill & Blast excavation
- 127 – 138 m^2
- 2x traffic & emergency lane,
- Separate smoke extraction duct
- Safety and Rescue layout
- Proposal of Electrical, Mechanical and Safety Installations

CLIENT FACTS

Overall costs

Total Overall costs	1’744 Mio. €
Total Service tunnel	5.6 Mio. €

Overview Project

- New freeway from Tehran to the Caspian Sea, crossing Alborz Mountains
- Road tunnel with 2 two lane tube
- Length each 6.1 km
- Service tunnel
- Diameter 5.2 m
- Length 6.1 km

Geology

- Volcanic and sedimentary deposits of the Lower and Upper Eocene (tertiary): tuff, sand- and silt-stone as well as conglomerates and breccia
- Anhydrite formations with gypsum karst and limestone
- Particularities: numerous fault zones, dangerous gases in high concentrations during the excavation (CH4 and H2S)
- Water inflow of up to 800 l/s
- Overburden of up to 800 m

Contact person

Teheran Shomal Freeway Company
Phone: +98 21 8808 9301
Email: info@tsfc121.com

AMBERG ENGINEERING

CHALLENGES

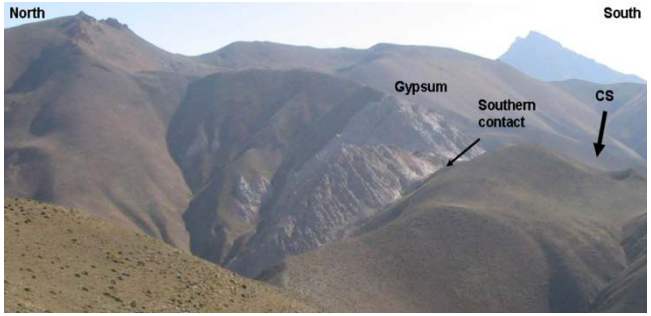
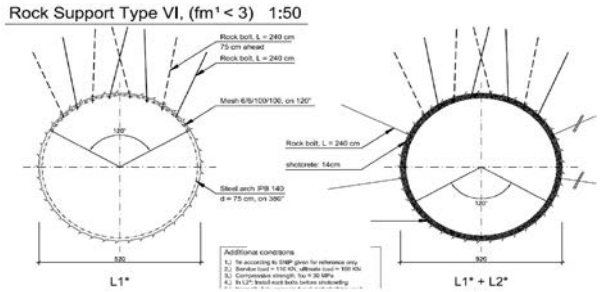


Photo showing hazardous geological areas

Complex Geology, fault zones, water ingress and gas (methane, H_2S)

- Site investigation only with geological mapping and geo-electric survey, no core holes drilled
- Predicted geological conditions are complex and overall heterogeneous.
- In the north, Triassic and Jurassic argillite with some sandstones and thin coal layers of Shemshak formation were expected, followed by a sandstone and then limestone formation.
- At TM ~3800, a 300 m thick fault zone was predicted, representing the Kandovan fault zone with a vertical displacement of some km's
- Further south, Oligocene clastic sediments (Kandovan Shale) are present, including massive gypsum / anhydrite bodies with a length up to 300 m on tunnel level. At the surface the gypsum shows massive karstic features with unknown extend.
- The main hazards identified were the unknown behaviour of the fault zone and karstic features in the anhydrite with related water / material inrushes. Furthermore, CH4 and H2S gases were predicted.

ENGINEERING APPROACH



Scheme of rock support

Single shell lining with shotcrete, rock bolts meshes and arches

- Rock support consisted of a variety of predefined rock support types
- Wire mesh in the crown for head protection against small stones
- Steel rings IPB 140 with 4 – 5 x 240 cm Swellex rock bolts in the crown every 75 cm plus wire mesh and 15 cm of shotcrete all round
- Site investigation ahead of the tunnel face by probe drilling and Tunnel Seismic Prediction (TSP)

TECHNICAL SOLUTIONS

Heavy support in areas of fault zones

Heavy support of unstable areas

- Presence of methane gas (CH4), high quantity water ingress even inrush of running ground, squeezing conditions resulting in blockage of the TBM
- Overall adverse conditions require various bypass tunnels to continue the excavation
- Blockage of the cutter head often occurred in collapsing voids or where fault zone or karstic void material at the transition into anhydrite formations collapsed against the cutter head

AMBERG ENGINEERING

CHALLENGES

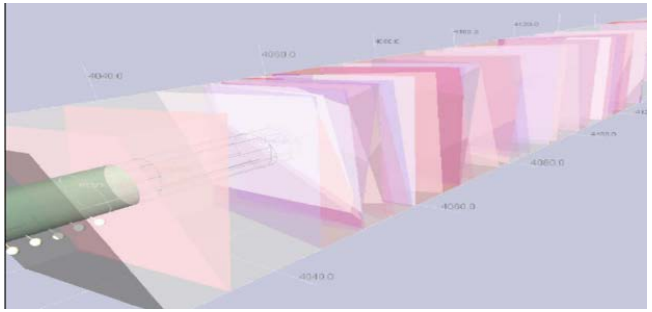
- Site in mountain region with difficult accessibility

- Water ingress zone, getting under control

- Heavy water ingress

ENGINEERING APPROACH

- Site access difficult in winter



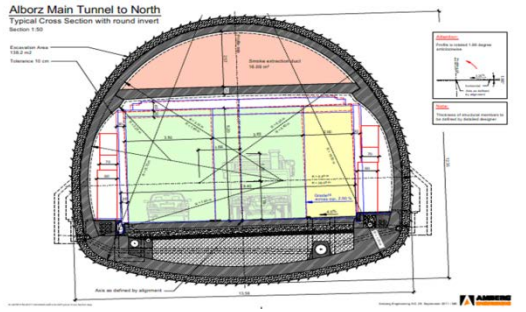
- Seismic investigation of fault zones ahead (TSP)

- H_2S gas, work with pressured air and masks

TECHNICAL SOLUTIONS

- Open gripper TBM

- Verification of TSP result by drilling ahead



- Profile of road tunnels built after service tunnel

AMBERG ENGINEERING

AMBERG KEY PEOPLE INVOLVED

Dieter Wenner
Civil Engineer
Geologist
Project Manager

dwenner@amberg.ch

S. Afrand
Senior Engineer
Project Manager

info@tsfc121.com

AMBERG TEAM @ WORK

AMBERG ENGINEERING