Harald WAGNER

CURRICULUM VITAE

Detailed

Name	Harald WAGNER, PhD PE
Profession	Consultant for Underground Works with 40 + years of professional experience in Underground Infrastructure Engineering Design & Project Management in Construction.
Date of Birth	September 19, 1941
Nationality	Austrian

EDUCATION

1974	Technical University Graz / Austria PhD Degree in Geotechnical Science
1970	Technical University Graz / Austria Masters Degree in Civil Engineering

TRAINING

1992	Geomechatronic Center Linz, associated with Research Institute for Symbolic Computation, University Linz / Austria
1972	Post Graduate Education, Prof. Steinfeld, Hamburg / Germany

AWARDS

2007	ITA Award (WTC 2007)
2004	ITA-Vice President, elected in Singapore
2002	Upper Austrian Government Economic Award “Pegasus”
2002	ITA (International Tunnelling Association) Member of Executive Council
2002	Certified Expert at Court for Tunnelling and Foundation Engineering
2001	Government Surveyor h.c.
2000	Austrian State Award Consulting
1983	Chartered Master Builder of Austria
1980	Chartered Professional Engineer of Austria
1974	Theodor Körner Award from the Austrian President

LANGUAGE PROFICIENCY

German: mother tongue
English: perfect (read, spoken, written)
Spanish: fluent (read, spoken, written)
Swedish: fluent (read, spoken, written)
French: fluent (read, spoken, written)
Slovenian: fair (read, spoken)

MEMBERSHIP

- Austrian Association of Engineers and Architects
- Austrian Society for Geomechanics
- Austrian Standardization Institute
- ASCE American Society for Civil Engineers
- German Society for Earth Work and Foundation Engineering
- International Society for Soil Mechanics and Foundation Engineering
- International Society for Rock Mechanics
- Austrian National Tunneling Society, Board Member
- International Tunneling Association
- SPET Society of Professional Engineers of Thailand, Member
- TUTG Thailand Underground & Tunnelling Group, Member
- TUST Tunnelling & Underground Space Technology, Editorial Board Member (2010)
- National Academy Research Council, Committee Member on Tunnels & Underground, Washington D.C., USA, (2000 – 2003).
- WTC (World Tunnel Congress) ITA 1997, „Tunnels for People“, Vienna, Austria. Head of ´Underground Consulting Group´.
- Tutor of ITA Working Group 2, “Research and Development”
- Member of ITA Working Group 17, “Long Tunnels at Great Depth” Austrian Federal Chamber of Engineers
- Consultant to the World Bank for more than 15 years.

COUNTRIES OF WORK

Austria, Germany, Switzerland, Italy, Czech Republic, France, Hungary, Poland, Cyprus, Canada, USA, Mexico, Puerto Rico, Colombia, Bolivia, Peru, Egypt, Iran, Iraq, Turkey, Vietnam, South Korea, PR China, Japan, Hongkong, South Africa, Thailand, Saudi Arabia.

PUBLICATIONS

More than 150 published scientific papers concerning all aspects of design, construction engineering and supervisions of underground facilities. Edited “TBM Tunnelling Trends” (1996) and “Tunnels for Tomorrow in Soil, Rock and Water” (2006). Lecturer for Universities and professional organisations (e.g. ITA, AMITOS, ASCE, ISCE, KSE) in Austria, Germany, USA, Japan, Korea, Italy, etc.

EMPLOYMENT RECORD

03/2009 - date

DR.HARALD WAGNER CONSULTING ENGINEER
50/20 Laddarom, Watcharapol Sukaphiban 5 Rd. Tarang Bangken, Bangkok, 10220, Thailand
Position held
Independent Consultant & Tunneling Expert

1985 – 02/2009

D2 CONSULT Dr. Wagner Dr. Schulter ZT-GmbH
Hirschgasse 32, 4020 Linz / Austria
Position held
Senior Partner and Managing Director
President of D2 CONSULT USA Inc.
Description of company
Engineering and Consulting for Tunnelling and Geotechnology with emphasis on innovative tunnelling concepts - headquartered in Linz /Austria with offices in Beijing / China, Bogotá / Colombia, Prague / Czech Republic, Berlin / Germany, Warsaw / Poland, New York / USA. Austrian State Award Consulting (2000).
Description of jobs and duties
Promoter of an innovative and synergetic Tunnelling Technology, combining the geomechanic philosophy of Conventional (NATM) Tunnelling with its cyclic - incremental construction elements, with parallel continuous operations of Tunnel Boring Machine (TBM) Technology and precast reinforced concrete Tunnel Lining Segments.
Chairman of the Geomechatronic Center Linz (GCL), which is a non profit institute situated in the Softwarepark Hagenberg / Austria. GCL is composed of research institutes from universities and tunnelling industry, to serve the tunnelling community with faster and more economic concepts (1992). Internationally recognized authority on both the New Austrian Tunnelling Method (NATM) and TBM-driven and segmental lined tunnels in hard-rock as well as soft-ground tunnels of various diameters.

1975 – 1985

Beton- und Monierbau GesmbH / Austria
Bernhard-Höfel-Straße 11, 6020 Innsbruck / Austria
Position held
Manager of engineering and design division
Description of Jobs and Duties
Structural and geotechnical planning and job preparation. Estimates with responsibilities in underground construction projects in head office and on construction sites.

1972 - 1974

Technical University of Graz / Austria
Department of Civil Engineering, Soil Mechanics and Foundation Engineering
Rechbauerstraße 12, 8010 Graz / Austria
Position held
Assistant Professor with Prof. Christian Veder
Description of jobs
Ph.D. Thesis in soil mechanics
Lecturer for architects in Soil Mechanics and Foundation Engineering.

1970 - 1972 **Geotechnical Laboratory Prof. Steinfeld, Hamburg / Germany,**
Alte König Straße 3, 22767 Hamburg / Germany
Position held
Civil Engineer in Prof. SteinfeldsTeam
Description of jobs and duties
Design and calculations for shallow and deep foundations, outstanding works on high rise buildings (Bauhof Bremen) and Nuclear Power Plant (Geesthacht).

CHAPTER I CONVENTIONAL (NATM) TUNNELLING

Involvement both with ongoing "engineering and design" and "research and development" projects and extensive lecturing. Involvement in design and construction of NATM-metro projects including running tunnels, stations and shafts predominantly in soft ground under groundwater influence beneath urban areas. Experience covers highway tunnels, railway tunnels and water tunnels in various ground conditions with shallow to high overburden.

2008 – 2010 **Sadr – Niayesh / Amir Kabir Road Tunnels, Teheran / Iran**

Detailed tunnel design and construction supervision for the longest tunnel in the north of Teheran. The length of the north tunnel is 2,628m and the south tunnel is 2,370m with a cross section of 120.07 m² using Road Header technology / NATM (New Austrian Tunneling Method).

2007 – 2008 **Metro Blue Line Extension, Bangkok / Thailand**

Detailed design including structural calculations of the TBS tunnels as well as of the NATM stations for the extension of the Metro “Blue Line”, which is consisting of 2 x 5,2 km single track tunnels and 2 NATM stations.

2007 – 2008 **Gautrain Rapid Rail Link, Johannesburg / South Africa**

Onsite project control for the 17 km long tunnel as well as bridges, tracks and other buildings along the high-speed railway section. Gautrain will bring a modern railway route to the area and with its connection to Johannesburg International Airport The network will be 80km long in total when both Phase 1 and 2 are completed.

2006 – 2008 **Highway Tunnels El Tablon – Pipiral, Bogotá / Colombia**

Detailed conventional tunnel and portal design including electromechanical design for ventilation, illumination, signalling, traffic control, etc. The highway between Bogotá and Villavicencio is of increasing importance for the economic development of the region with constantly growing traffic. Subsequently the present project with a total of 16 individual tunnels has been given high priority by authorities.

2005 – 2007 **Mumbai Sewer Rehabilitation / India**

Member of the Arbitration Tribunal in the dispute between Mumbai Municipality Corporation and Contractor. Evaluation of claims related to Technology for rehabilitation of old and deteriorated brick layer sewers by using reaming coating and installing new inlining with gap grouting of the annular space. Total length amounts to 2.5 km.

2002 - date **Brenner Eisenbahn, Lower Inntal Valley / Austria**

Attendant control and technical expert between all units of the construction. Nominated Tunnelling Expert for NATM and TBM sections in construction, Member of Evaluation Committee for Double Shell and Single Pass Mining Segments.

2000 - 2001 **Central Light Rail Link Seattle / USA**

Tender design with regard to the Metro Stations of First Hill, Pacific Station, 45th Street and the running tunnels according to the NATM technology. The alignment with a total length of 7.3 km and an average overburden of 65 m is located in clayey and sandy soil formations. Station length in average 180 m, excavation area of the platform tunnel 97 m² and of the single track tunnels 32 m².

2000 **Highway Tunnel Spital / Semmering / Austria**

Tunnel technical expertise to evaluate an accident with fatal consequences for the personnel, working in the tunnel on behalf of the Republic of Austria, Provincial Court of Leoben, Styria. The accident happened in the morning of March 4, 2000. The objective of the expertise was to clarify responsibilities of the construction company in regard to given geologic circumstances.

1999 - 2002 **East Side Access Queens – Manhattan, New York / USA**

The Long Island Rail Road's East Side Access (ESA) project will bring LIRR trains from Queens into Manhattan's Grand Central Terminal through a series of tunnels, numerous caverns and one platform station. Technical assistance with regard to the application of NATM & TBM tunnels in various geological formations and sensitive urban environmental conditions. The whole contract with a total length of 6.6 km is split up in rock sections (2,300 m) and tunnels in soft ground (3,300 m).

1999 - 2008 **ICE High Speed Railway Nuremberg – Ingolstadt / Germany**

Construction Supervision and Project Management for the construction of 3 NATM double track tunnels with a total length of 5,280 m. Main items of the contract are: Geological- and geotechnical investigations, consultancy services, review of the detailed design and application of NATM technology.

1999 - 2009 **Brenner Eisenbahn, Lower Inn Valley, Tyrol / Austria**

High speed railway Wörgl - Baumkirchen. Design review for 4 double track NATM high speed railway tunnels with a total length

of 20.5 km. The excavation area is in the range of 100 and 150 m², the length varies between 450 m (min.) and 8,305 m (max.). Evaluation of alternatives with regard to the application of TBMs.

1999 - 2002 **Minillas Extension Project, 'Tren Urbano' / Puerto Rico**

Technical assistance in evaluation of the Minillas Extension Project during design. Comments regarding New Austrian Tunnelling Method (NATM) design concepts and proposed construction techniques. Services as member of Tren Urbano committee for the

Design / Build contract. The project consists of 2 NATM Stations 'Minillas' & 'San Mateo' in shallow overburden and running tunnels with a total length of 1.6 km.

1998 - 2001 **Subway Stuttgart, 'Contract 601' / Germany**

Construction supervision and technical management for the circular NATM subway tunnel with an inner diameter of 7 m and a length of 2,200 m. The tunnel, located in clay/silt formations, has an overburden of 25 m and is situated under the runway of Stuttgart airport. The contract consists of 1 tunnel, 2 shafts (15 m diameter, and 22 m diameter respectively) and 1 emergency gallery.

1998 - 1999 **Tunnel 'Girardota', Medellin / Colombia**

Design management and consultancy including tender document preparation for the doublelane road tunnel (tunnel length of 805 m, tunnel section of 75 m²) in accordance with the principles of the NATM. The geological conditions are to be classified between rock class I-IV (hard rock – fractured and slickensided rock mass).

1998 - 1999 **Tunnel 'Hai Van Pass', Da Nang / Vietnam**

Design management including design review for a 2-lane road tunnel in accordance with the principles of the NATM with a total length of 6,140 m.

The project consists of the main tunnel (85m²), the evacuation tunnel (55m²), 15 cross passages and 2 ventilation tunnels. Design and optimisation of the ventilation system. The geologic formation is classified predominantly in good rock. Consultant to NK/LBII.

1997 - 2002 **Tunnel 'Buenavista', Villavicencio / Colombia**

Design and tender document preparation including structural calculation for the 2-lane road tunnel according to the principles of the NATM along the route Bogotá – Villavicencio. The tunnel with a cross section of 75 m², a length of 4,509 m crosses through varying geologic conditions with water inflow and real rock pressure resulting in shotcrete lining deformations. Construction Supervision by Union Temporal DIS/EDL – D2 Consult with detailed record of construction progress.

1997 - 1998 **Tunnel 'San Rafael', Cotapata – Santa Barbara / Bolivia**

The 2-lane road tunnel with a length of 1,300 m along the route Cotapata – Santa Barbara, east of La Paz, is located approx.

3,500 m above sea-level and is to be built in accordance with the principles of the NATM in different rock formations. (Rock Class I-IV). Design and tender document review including technical studies with regard to tunnel portal construction.

1996 - 1998 **Tunnels 'Tobiagrande – Puerto Salgar' / Colombia**

Tender design phase III and site investigation for 15 NATM double-lane tunnels of motorway predominantly in good rock conditions, partly fissured and faulted, review and approval of phase II and phase III, on behalf of the Ministry of Transportation between Bogotá and Medellín. Cross-section 70 – 95 m², tunnel length in total 18.5 km.

1996 **Tunnels 'Tobiagrande – Puerto Salgar' / Colombia**

Review and approval of phase II design and site investigation for 15 double-lane tunnels of motorway in predominantly good rock conditions, partly fissured and faulted with NATM on behalf of the Ministry of Transportation between Bogotá and Medellín. Cross-section 85 m², tunnel length in total 18.5 km.

1995 **'Wanjiazhai Yellow River Diversion Project' / PR China**

Consultancy review and design supervision for underground pumping stations excavated and supported according to the principles of NATM. Rock mechanical comparison of 3 versus 5 caverns. Tunnels with 5 m diameter and a total length of approx. 200 km for water supply of Shanxi province. Reports resulting from expert analysis include general and detailed recommendations for tunnel construction. Additional consulting activities for aspects of construction including dams, pumping stations and aqueducts.

1993 **Water Diversion Tunnel 'Dhiarizos' / Cyprus**

Design review and back analysis for critical section in high pressurized squeezing rock with structural instability and invert heaving between km 4.0 and km 8.0 (total section length 14.5 km, excavation diameter 3 m), supported according to NATM principles.

1992 **High-Speed Railway Tunnel 'Lambach' / Austria**

Arbitrator and Consultant for double-track railway tunnel in gravelly cohesionless soils with NATM. Redesign of support system directly related to deformation criteria. Cross-section 120 m², section length 1,200 m.

1991 **Tunnels 'Balcova/Karsiyaka', Izmir, Turkey**

Design of 5 double-tube tunnels with 3 lanes each as part of the Izmir-Ring-Road project. NATM with drill & blast in varying rock conditions, including coordination of all geologic survey and electrical and mechanical design. Cross-section 180 m², total length of tunnels 6.0 km.

1991 **Metro Los Angeles 'Red Line', USA**

Conceptual studies and preliminary design of 4 metro stations. NATM in soft ground with some groundwater. Settlement computations by FEM-analysis. Detailed cost estimates. Cross-section 95 - 270 m², station length 4 x 180 m.

1990 **Tunnel 'Saalbach / Hinterglemm' / Austria**

Consultancy and design review for 2 single-tube highway tunnels using NATM with drill & blast in soft rock with groundwater. Difficult geologic conditions in alluvial formations of creeping slopes. Soil improvement with jet-grouting. Turtle tunnels in portal areas. Cross-section 90 m², tunnel length 1.2 km.

1989 **Tunnel 'Selatin', Izmir / Turkey**

Supervision of design and recommendations for initial and final lining optimisation, evaluation of geomechanical measurements (cross section 120 m², tunnel length 3 km). Double tube, triple-track highway tunnels in partly shiest and partly limestone conditions with groundwater using NATM with drill & blast operation.

1989 **Metro Munich, Section 'Candidplatz' / Germany**

Detailed design and review of support in construction (cross-section approx. 36 m², total length of tunnels 2,075 m) including openings for cross passages and pump sumps. Four single-track subway tunnels with NATM under compressed air in soft ground with groundwater prepared for future construction above and adjacent to the tunnels. Clayey silts and silty sands with quaternary layers.

1986 **Metro Washington, Section 'E -005/ Greenbelt Route' / USA**

Consultancy and design of NATM-driven tunnels, followed by design of NATM-driven station and shafts, for the first time under soft ground conditions in the USA, with little groundwater influence. Preparation of contract documents for tunnels and Fort Totten Station on Greenbelt Route. Prepared design of twin bore tunnels, length 2 x 300 m, using NATM technology and prepared specifications and cost estimates. Design of the NATM-Station 'Fort Totten' (164 m² in soft ground by multiple drifts, using Finite Elements method for stress distribution. Designed jet grouting for soil stabilization. Winner of ACEC's 'Engineering Excellence Award'. NATM-design bid was successful against conventional design. Construction supervision and design review for client on site. Station cross section 164 m², tunnel length 2 x 300 m).

1986 **High-Speed Railway Tunnel 'Escherberg', Hanover – Würzburg / Germany**

Structural computations and construction concepts for NATM driven, double-track railway tunnel in soft rock with some groundwater. Evaluation of drill & blast scheme, rock support and

advanced side galleries, geomechanical measurement interpretation. Cross-section 120 - 140 m², section length 2.8 km.

1985 **High-Speed Railway Tunnel ‘Rossberg/Steinberg’, Hanover – Würzburg / Germany**

Drill & blast construction concepts for NATM-driven, double-track railway tunnel in fairly good rock. Evaluation of rock classification and elaboration of claim concepts for the contractor, Cross-section 120 - 140 m², section length 2.4 km.

1984 **Highway Tunnel ‘Hohentwiel’, Singen / Germany**

Consultant and Supervisor in all technical aspects during construction of two double-lane tunnels. Section length 850 m.

1984 **Tunnels ‘Honam - Munsan’, Kwangju / South Korea**

Double-tube highway tunnels, driven by NATM with drill/blast in mostly hard rock conditions. Structural design and lining optimisation by correlation between FEM-computation and geo-measurements. Construction supervision for client. Cross section 90 m², section length 4 x 800 m.

1983 **Metro Vienna, Section ‘U-6/1 - Pottendorfer Straße’ / Austria**

Supervision of the mining sections, in particular of the special proposals shotcrete under compressed air, insulation, and crown advance. Two finite elements calculations: 1) Comparison of the AE-groundwater lowering with the SV-shotcrete under compressed air, in particular with a view to different settlement behaviour; 2) Comparison of the divided with the undivided crown advance with a view to different settlement behaviour. Section length 450 m.

1983 **Tunnel ‘Zahko’ / Iraq**

Consultation in planning and design of the tunnel within the scope of Iraq expressway No. 2. Investigation of several variants for the alignment. Assistance in working out the drilling tender. Basic structural investigations. Elaboration of the tender for the tunnel.

1982 **Tunnel ‘Diana’, Bad Bertrich / Germany**

Consultant and supervision during the tender stage. Construction of drill & blasting of double-lane road tunnel, including hillside support measures. Section length 230 m.

1982 **High-Speed Railway Tunnel ‘Altengronauer Forst’, Hanover – Würzburg / Germany**

Double-track railway tunnel of the new construction section of the German Federal Railways. Supervision of preparation of works in drill & blast NATM construction. Section length 2,300 m.

1982 **Test Tunnel ‘Waldau’, Stuttgart / Germany**

General construction supervision for the construction of 16 m deep, back-anchored construction pit, open on one side and accessible via ramp, with a double-track tunnel. Tunnel securing

evidence involving comprehensive geomechanical measurements. Section length 25 m.

1982 **Metro Stuttgart, Section 13 Tunnel ‘Hasenberg’ / Germany**

Consultant with work preparation responsibilities. L = 2 x 2.1 km

1981 **Metro Mexico City / Mexico**

Consultant in planning and design as well as in construction applying new construction methods in tunnelling, in particular the New Austrian Tunnelling Method. Manager of the consulting group in Mexico. Scope of contract. Line 7 (consisting of 13 km of double-track and single-track tunnels) and nine stations constructed by means of the mining method, and one station constructed by means of the cut-and-cover method.Line 3 South (approximately 4 km of single- and double-track tunnels) and three stations constructed by means of the mining method, and one station constructed by means of the cut-and-cover method. Characteristics of consulting contract: Construction of metropolitan traffic tunnels beneath urban areas with an overburden of less than two diameters close to strongly charged foundations with irregular stratigraphic subsoil conditions. Measuring results obtained from gauge measurements, convergency measurements, extensometer measurements, as well as measurements by means of inclinometers, of lateral shiftings and topographic control measures, prepared for implementation in construction.

1981 **Tunnel ‘Apollo’, Bad Bertrich, Germany**

Consultant and supervision of technical planning in the bidding stage and drill & blast construction. Tunnel construction by means of the cut-and cover and mining method. Double-lane road tunnel with approx. 80 m hillside support for a subsurface road. Section length 440 m.

1981 **Metro Vienna, Section ‘U3/5 - Landstrasse’ / Austria**

Consultant and supervision of special proposal for the single-shell execution of the slurry-trench wall/cut-and-cover sections under partial application of post-injectionable precast elements; alternative buildings underpinnings with bored piles driven on the rake. Section length 500 m.

1981 **High-Speed Railway Tunnel ‘Dietershahn’, Hanover – Würzburg / Germany**

Consultant and supervision of technical management of various special proposals, including the Carinthian cut-and-cover construction method, in the bidding stage. Section length 7.3 km.

1980 **Highway A14 / Tunnel ‘Pfänder’, Bregenz / Austria**

Technical and financial consultant during construction and representative of the Joint Venture in NATM-tunnelling with drill & blast operation in water sensitive soft rock.

1980 **Metro Ankara / Turkey**

Consultant for the construction of the first diameter line; City Park Station to 'Inönü' Station, in particular of the underground sections constructed by means of the slurry-trench-wall/cut-and-cover method a well as by means of the mining method with drill & blast, including the respective stations, with cost estimate. Section length 1.6 km, cross section 65-90 m²).

1980 **Tunnel 'Du Toitskloof' / South Africa**

Consultant and supervision of bid preparation for a motorway tunnel by means of the freezing method and NATM. Section length 4.5 km, cross section 85 m².

1980 **Tunnel 'West Tangent', Bochum / Germany**

Consultant and technical supervision of bid preparation and construction (section length 2 x 600 m by means of NATM-method with drill & blast, approx. 290 m thereof by means of the cut-and-cover method).

1978 **Singapore Metro , Alignment Study Phase**

Consultancy services provided for LTA (Mr.Pok) On site meetings, preparation of reports on the applicability of NATM versus TBM in specific areas (soft ground and hard rock) of the mined sections.

1978 - 1979 **Metro Hongkong, Contract 305 / Hongkong**

Overall management of planning engineering and design. Elaboration of special proposals for mechanical driving, ground stabilization, as well as for NATM-construction of 'Tai-Wo-Hau' Station (section length 2.4 km, along 'Tsuen-Wan' extension).

1978 - 1985 **Metro Munich, Section '5/9-5' / Germany**

General management of engineering, design and planning during construction of single - track metro tunnels, section length 2.5 km. NATM sections, including binocular type metro station 'Theresienwiese'. Full time involvement of two years (1979 - 1980) within four years (1978 - 1981) at construction site.

1978 **Metro Washington, 'Huntington Route' / USA**

Assistance in developing of value engineering, planning and design task according to NATM, including special proposals and improved design for tunnel support.

1978 **Metro Washington, 'Tenley Circle Station' / USA**

Development of value engineering change proposed for construction of Tenley Circle Station based on NATM principles.

1977 **Metro Washington, Station 'Wheaton' / USA**

Head consultant for special proposal for construction in accordance with the principles of NATM. Redesign with basic

structural considerations of the station by means of the mining method, originally planned for cut-and cover construction. Assistance in development of the special proposal for construction of Station 'Wheaton' for the Washington Metro in decomposed rock, according to NATM. Value engineering, feasibility study and redesign of originally planned cut-and-cover method of construction into the mining method.

1977 **Tunnel 'Ganzstein', Expressway S 6, Mürzzuschlag / Austria**

Consultant for special proposals for drill & blast excavation and soil improvement (section length 2.2 km, cross section 85 m²).

1974 **Metro Bochum, Station 'Berliner Platz', Bochum / Germany**

Management of structural design in construction by means of NATM (section length 614 m). Full time involvement for one year (1974 - 1975) at construction site.

CHAPTER II MECHANIZED (TBM) TUNNELLING

Performance of 2 x 5 year program for Research & Development of TBM-driven tunnelling in varying geologic conditions with segmental liners. Hardware system modules including segment design, membrane and gasket design, mechanical connectors and plugs. Software system packages including survey, TBM- and erector-controlling. Manufacturing program for lining segments.

Involvement in design and construction of one-pass tunnel lining system under soft ground conditions in Germany. System utilization in America, Middle East and Europe by combining high precision segments with joint fastening devices.

2007 – 2010 **Metro Blue Line Extension, Bangkok / Thailand**

Services in JV included detailed design, structural calculations of the EPBM TBM Tunnels as well as Construction Supervision of the mined section (2010-2014). Mined Section includes 2 x 5,2 km single track tunnels and 2 NATM stations.

2005 – 2008 **Wuhan Yangtze River Tunnel / PR China**

Technical consultancy services during design and construction. The Wuhan Yangtze River Tunnel is located between First Yangtze Bridge and Second Yangtze Bridge. Both Face Pressure TBM Tunnels with 2 lanes are connecting Hankou Dazhi Road in the north with Wuhan Yonyi Road in the south. It will be the main road passing Yangtze River into the city. Tunnel Length L=2x2.65 km. Safety Slides replaced Cross River Passages.

2003 - 2004 **WSKE Collector underneath Vienna River, Vienna / Austria**

Face Pressure TBM water tunnel in Vienna with a length of 2.5 km. The tunnel has an excavation diameter of 8.30 m, an inner diameter of 7.50 m, segment thickness is 40 cm. Construction

included 1 service shaft and 5 discharge shafts. Services included detailed design of lining segments, formwork, segment reinforcement, structural calculation, and construction consultancy.

2002 - date **Brenner Eisenbahn, Lower Inntal Valley / Austria**

Attendant control and technical expert between all units of the construction. Nominated Tunnelling Expert for NATM and TBM sections in construction, member of Evaluation Committee for 2-pass and 1-pass Segmental Linings.

2000 - 2004 **Koralm Tunnel – High Speed Railway / Austria**

Double tube single track tunnels connecting Graz (Styria) with Klagenfurt (Carinthia) in the South of Austria, crossing Koralm mountain range in tunnels of approx. 35 km length, with approx. 9.5 m diameter. Services provided included TBM expertise, in hard rock with faulted areas. Logistics, TBM suitability of various alignments, segment design and production.

2000 - 2002 **Sewer Tunnel Biesdorf – Wassmansdorf, Berlin / Germany**

Services included design and structural calculation of segmental linings for a sewer tunnel with approx. 5.4 km length and an inner diameter of 3.00 m. The tunnel will be excavated by TBM.

2000 - 2003 **By-Pass Route Westtangente, Linz / Austria**

Services include Feasibility Study regarding the by-pass route “Westtangente”, which beneath the river Danube with a total length of 4,400 m. The study deals with the review of the designed alignment, the development of ventilation systems, cross section of the TBM tunnels and detailed cost estimate.

1999 **RM-VT Roma Trastevere–Roma S. Pietro, Rome / Italy**

Services included evaluation of bids for manufacturing and delivering of TBM for railway tunnel with a length of approx. 1.8 km and diameter of 8.0 m.

1998 - 1999 **Sir Adam Beck Hydro Power Tunnels, Niagara Falls / Canada**

Consultancy for hydro power tunnel, driven with TBM, inner diameter 12.5 m, tunnel length 10 km. Detailed evaluation of one pass precast reinforced concrete Tunnel Lining Segments with regard to geometry and gap grout materials in squeezing rock conditions with internal water pressure. Review of detailed design and contract documents.

1996 - 2000 **Wanjiazhai Yellow River Diversion Project / PR China**

Team Leader for WYRDPC (Administration for Yellow River Diversion Project) with responsibilities in the joint design team consisting of TIDI (Tianjin Design Institute), Tianjin, CCPI (Canada-China Power Incorporated), Montréal and D2 Consult, Linz. Detailed design and tender preparation for TBM-driven and segmental lined tunnels, NATM tunnels and NATM pumping stations.

1993 - 1996 **Innerurban Railway Tunnel EOLE, Lot 35B, Paris / France**

Services provided included design, numerical analysis of precast segmental linings in soft ground with EPBM – TBM and construction consultancy. Twin tunnels of 2 x 1,670 m, excavation diameter 7.40 m. FEM Analysis of geomechanical measurements, influences during construction, installation and operation considering non-linear behavior of ground, interaction between linings of adjacent tunnels. Optimization of tapered rings following specified alignment requirements.

1993 - 1995 **Railway Tunnel 'St. Clair' / Canada - USA**

Services included Technology Evaluation of Tunnel, L=2.85 km. Technology. Recommendation for precast concrete one-pass linings underneath the St. Clair River. Recommendation for EPBM-TBM Technology. Recommendations provided for Canadian National Railways/Grand Trunk Western as owner within Technical Committee on the team of Klohn Leonoff , Consulting Engineers, Toronto.

1993 - 1995 **Innerurban Railway Tunnel 'Passante Ferroviaro Milano' / Italy**

Services included consultancy in Design & Construction for EPBM-TBM tunnels with 1- pass tunnel linings, using mechanical connectors. Tunnel length 4 km, excavation diameter 7.5 m.

1991 **Railway Project 'Tunnel Tirol' / Germany - Austria - Italy**

Services included Design & Review of innovative railway-tunnel project. Tunnel excavation concept with TBM-technology, yielding lining system. Railway operation with linear motor system, Facing varying hard and soft rock conditions with hazardous water infiltrations. Tunnel length 2 x 112 km, excavation diameter 6.5 m.

1990 **'Boston Harbor Outfall Tunnel', Boston / USA**

Services included Design & Construction Consultancy of Tunnel Linings with hard rock TBM-excavation in argelitic ground. Tunnel length 14 km, excavation diameter 8 m.

1977 **Tunnel 'Isfahan' / Iran**

Shield driven open face TBM-tunnelling concept for drinking water supply tunnel, in alluvium conditions with precast concrete lining segments with high pressure prestressing gap grouting. Section length 8.7 km, diameter 4.5m.

1977 **Metro Munich Section 5/9-5, Munich Germany**

Design and construction of 1.Universal Ring for TBM driven Tunnels. Precast reinforced concrete lining segments, 1-pass linings without key stone, open face TBM-driven tunnels under soft ground and groundwater conditions. Section length 4 x 550 m, diameter, 6.7 m.

1975 **Tunnel 'Kantara', Ismailia / Egypt**

Design and construction concepts and project management for closed face TBM-driven tunnels for highway and railway with cast iron segmental lining under compressed air and groundwater lowering. Section length 2.7 km/4.3 km; diameter 9 m / 4.2 m.

CHAPTER III ENERGY & INFRASTRUCTURES

Consultancy Services and Expert Panel Member involvement in Design, Review and Construction Management Advisor of major infrastructure projects.

2011 – 2015 **Kabeli A Hydropower Project, Amarpur/Panchami, Nepal**

Project review for the Kabeli A Project, which has been designed as a Hydropower Generation Scheme. Services include evaluation and recommendation for the best Tunnel Technology of the headrace with approx. 4.3 km pair tunnels, Surge Shaft of approx. 50 m depth, Powerhouse, Penstock, and Tailrace of approx. 460 length. When completed, the project will generate approximately 45 Megawatt of energy in a typical year.

2010 – 2013 **JTC Oil Terminal , Singapore**

Jurong Town Corporation (JTC) in Singapore builds a new oil terminal. Parts of this terminal are oil storage caverns with a capacity of approx. 1.5 Million m3. The entire facility will be built below sea level. The zone where the facility will be located, has a considerable number of rock joints and fault zones. Two shafts permit access to the caverns, each with a diameter of 25 m and a depth of approx. 130 m. From these shafts access tunnels lead to the Underground Chambers (Height 27m, Width 20m, Length 300m). Services provided include performance of independent Technical Review and Judgement Services.

2010 – 2011 **Khourang III Water Transmission Tunnel , Esfahan, Iran**

Water Transmission Tunnel of approx. 23 km length with approx. 5 m diameter for the Water Supply of Esfahan and the greater Esfahan basin (residential area and agricultural use). Water from the Khourang River is transferred through karstic rock with major fault zones and unexpected high water ingress. Services provided include in situ consultancy and tunnel technical advisory services for contractor and owner.

2008 – 2011 **Vishnugad Pipalkoti Hydroelectric Project, Chamoli / India**

Project control for the Vishnugad Pipalkoti Project, which has been designed as a 444 Megawatt, hydropower generation scheme. Services include evaluation and recommendation for the TBM construction of the headrace & tailrace tunnels with approx. 15 km of length, Surge Shaft, Underground Machinehouse and Underground Powerhouse. When completed, the project will generate approximately 1,800 Megawatt of energy in a typical year.

2007 – 2011 **RHEP Rampur Hydroelectric Project, Shimla, India**

Rampur Hydroelectric Power Project (RHEP, 412 MW) is owned by SNJVL Hydropower Corporation. The Project length comprises of approx. 15 km of HRT, the excavation diameter ranges from approx 8 – 10 m, Tailrace Tunnel, Surge Shaft and Powerhouse. Services provided include Consultancy in Conventional (NATM) Tunnel Design and Construction.

2009 – 2014 **LHEP Luhri Hydrelectric Project, Shimla, India**

Luhri Hydroelectric Power Project (LHEP, 775 MW) is owned by SNJVL Hydropower Corporation. The estimated length of HRT is approx. 38 km, with 8 planned adits, Surge Shaft, Tailrace Tunnel, and Underground Powerhouse. Services provided include Independent Project Review focused on the best choice of Tunnelling Technology (Conventional Tunnelling vs. TBM Tunnelling) based on Risk Assessment and comprehensive Cost Estimation.

2000 – 2004 **Tongbai Pumped Storage HEP Station, Hangzhou / PR China**

Expert services for underground construction including NATM power tunnels (9m diameter), inclined shafts (9m diameter), Underground Power house (L x W x H = 172m x , 24m x 54m), transformer hall (L x W x H = 163m x 18m x 29m) and tail race tunnels (7m diameter) in competent rock with reasonable fault zones and little water. Station capacity is 1200 MW.

1998 – 1999 **Hydro Power Station 'Dai Ninh' / Vietnam**

Member of Panel of Experts, acting as Geotechnical & Tunnelling Consultant, contracted by "Electricity of Vietnam" to provide **technical expertise for this Hydro Power Station. Services included** field investigation of the project. Major structure has been a tunnel, inner diameter 4.4 m, length 11.2 km, in different types of rock including fault zones. Expertise has been reflected in several reports, containing evaluation of detailed design and tender documents, structural and geotechnical evaluation and cost estimation comparing TBM and NATM Tunnel Methodologies.

1999 **Warnow River Crossing, Rostock/Germany**

Expert Services for Undercrossing the Warnow River for a double lane, double tube road tunnel in northern Germany using Immersed Tunnel Technology to float prefabricated reinforced concrete elements. Design review of immersed tunnel with regard to geological and hydrological criteria, structural design risk, risks analysis and risk assessment. The construction with a width of 22.5 m and a height of 8.5 m consists of 2 boxes with 2 lanes. The immersed tunnel with a length of 800 m crosses through soft ground conditions. The overburden between tunnel roof and riverbed is of 2.10 m.

1994 – 1998 **Panamericana Norte y Sur, Panamericana Central, Lima/Peru**

Geotechnical Investigations along the Pacific Coast north and south of lima. The public road network in this area with a total length of approx. 500 km is endangered by geological and hydrological hazards. Consultancy services included slope stability analysis, river erosion analysis, technical and economical

assessment of alternative concepts, recommendations and review of design concepts.

1994 **Hydropower Station 'Ybbs', River Danube / Austria**

Review and structural design for support of 40 m deep excavations and NATM driven inlet tunnel (12 m diameter) for the 7th power generating machine in soft ground and rock, beneath the existing Hydropower Station.

1993 – 1994 **Motorway A3 Swiecko - Kolo, Poland**

Engineering services for Economical and Technical Feasibility Study for the first section on polish territory of motorway Connection from Paris via Berlin to Warszawa and Moscow. Contract with polish Autostrada Wielkopolska S.A.

1989 – 1990 **Panther Line, Subway Graz, Styria, Austria**

Engineering services for the Feasibility Study provided by the Professional Engineers Association. Located in the South of Graz, the Panther Line was supposed to improve traffic infrastructure both for rail and road. Connection of Terminal and adjacent facilities with future mass transit system and with European high speed railway network.

1988 **Hydropower Tunnel 'Wagrain', Salzburg / Austria**

Consultancy services and studies during construction for tunnels in frequently changing rock conditions, excavated with NATM and with hard rock TBM, with cast in place final lining. Cross-section 20 m², tunnel length 8 km.

1988 – 1989 **Roman Line, Subway Linz, Austria**

Engineering services for Conceptual design and project development of inner urban underground mass transit system by ring like connection of all entering existing local railway lines.

1987 – 1988 **Underground Parking Garage, Linz, Austria**

Engineering services for Conceptual design and project development including construction cost estimate and construction scheduling of inner urban underground parking facility in weathered granite underneath the medieval Linz Castle.

1984 **Hydropower Tunnel 'Obere Sill', Innsbruck / Austria**

Study report concerning the construction with respect to technical aspects of driving by means of road-header in friable rock conditions. Support measures and negotiations with the client. Section length 5.8 km, diameter 3.6 m.

1975 **Hydropower Cavern 'Waldeck II', Kassel / Germany**

Concluding studies and controls for underground cavern during construction (excavation cross section approx. 1300 m2) supported by means of systematic roof bolting and two layers of

shotcrete lining with an average lining resistance provided by deep and short bolts, following NATM principles.