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## **Kurt Zeidler, PhD, CEng, FIMMM**

Principal

### **Years of Experience**

40

### **Education**

Ph.D., Geology and Engineering Geology, University of Salzburg, 1987

### **Professional Registrations**

Chartered Engineer (CEng)

### **Professional Associations**

Member of the Austrian Society for Geomechanics (Österreichische Gesellschaft für Geomechanik)

Member of International Society of Rock Mechanics

Member of British Tunnelling Society

Fellow of Institute of Materials, Minerals and Mining (FIMMM)

Professional Member of the American Society of Civil Engineers (ASCE)

Member of the Society for Mining, Metallurgy and Exploration

### **Key Qualifications**

Mr. Zeidler has over forty years of experience in geotechnical engineering, project management, design and design checks for underground construction and slope stabilisation projects in rock and soil. His primary expertise lies in the design of modern excavation and support systems for tunnels, underground stations and caverns in hard rock and soft ground in urban areas. He is called upon as an expert consultant for projects worldwide, including the United States, Europe, North Africa, Middle East, Australia, and Asia.

### **Experience Record**

Kurt Zeidler has gained extensive experience:

- Ground improvement methods for all types of soft ground, including groundwater draw-down, grouting, chemical grouting, jet grouting, compensation grouting and ground freezing
- Rock tunnel construction and slope support
- Tunnel support measures, including shotcrete, steel liner, segmental lining and ground pre-stabilisation
- Various tunnel construction methods, including cut & cover, semi-cut & cover and mining methods (SCL/NATM, TBM)
- Tunnel pre-support, including jet grouting, tube-a-manchette grouting, permeation grouting, pre-spiling methods, metal sheeting and slab methods
- Slope support design for rock and soil slopes for cuttings, portal faces, intake and outlet structures; slope and open cut support measures include rock bolts and anchors, soil nail walls, bored piles, soldier piles and lagging, concrete retaining walls and reinforced soil
- Rehabilitation and repair of existing tunnel schemes as well as waterproofing of new and existing tunnels
- Tunnel ventilation and fire, life & safety aspects
- Development of specifications and contract conditions.

Mr. Zeidler has carried out feasibility studies, design of alternative methods, tender and

detailed designs, development of specifications and contractual documents, design reviews, expert advice, expert witness services and site supervision for:

- Road and railway tunnels in rock and soil, in stable, highly unstable and squeezing ground conditions
- Metro running tunnels in soft ground
- Metro station schemes in soft ground and rock
- Tunnel crossings and bifurcations in soft ground and rock
- Light railway/bus tunnel in soft ground and ground freezing under shallow cover and surface structures
- Large span road tunnels in water saturated soft ground (silt, sand, clay) under shallow cover
- Tunnels in tectonised and tectonically active zones
- Rock tunnels, drill and blast excavation
- SCL/NATM and TBM constructions
- Slope support
- Tunnel rehabilitation
- Compensation grouting and fracture grouting

Relevant past project experience includes:

### **Railway/Transport**

*HS2 (High Speed Railway 2), N1 Bromford Tunnel, UK (2021 – present):*

HS2 is a new high-speed rail line that will be the backbone of the UK's rail network, Phase One of this project will connect London to Birmingham by 2026. GZ are carrying out the independent Category III design checking services for the Bromford Tunnel, located in Birmingham. The checking works include 5.6km long, twin bore TBM tunnels with cross passages and portal structures. Kurt Zeidler is acting as Checking Team Leader.

*Western Rail Link to Heathrow, Network Rail, London, UK (2019 – present):*

The Western Rail Link to Heathrow is a new two-track rail line from Langley Station on the Great Western Main Line to an end-on connection with the existing Heathrow Express line at the west end of Heathrow Terminal 5 Station. The structures along the route include a retained cut (400m), C&C tunnel (500m) and twin bored TBM tunnel (4km) to two temporary shafts that will be used to recover the TBMs. The final 160m-long section of the tunnel will be an open face excavation with SCL which connects into existing stub tunnels at Heathrow Terminal 5 Station. Within the alignment of the bored tunnels two intervention/ventilation shafts, eight SCL cross passages and four ventilation adits will also be constructed. The TBM tunnels pass beneath the M4 and M25 Motorways. The proposed line-speed is 75 mph. Mr. Zeidler acts as expert advisor on tunnelling to the Client.

*Category 3 Check of Euston Replacement LU Substation, Vent Shaft and Tunnels, Euston, London, UK (2019 – Present):* The construction of the future HS2 Euston Station requires the demolition of the existing LU traction substation and vent shaft that provides power to the Northern Line trains and vents the Northern Line platforms. A replacement traction substation and vent shaft building will be constructed. The tunnels connecting the new vent shaft with existing LU infrastructure will be formed with two linings, a fibre reinforced sprayed concrete primary lining and a cast-in-place concrete secondary lining with a waterproofing membrane between the linings. The tunnels will be unloaded during the excavation for the future HS2 station and subject to significant surcharge loads generated by the future oversite development. Mr. Zeidler is the Independent Category III Check team leader.

*HS2 (High Speed Railway 2), C1 Chiltern Tunnels, UK (2017 – present):*

HS2 is a new high-speed rail line that will be the backbone of the UK's rail network, Phase One of this project will connect London to Birmingham by 2026. The Chiltern tunnels pass through Chalk with varying degrees of weathering, dissolution features and faults. GZ is working on tunnel design and serving as a geotechnical specialist as member of the Align JV in Area Central, specifically on the C1 work package (Chiltern Tunnels). GZ's main scope of works includes the 16km-long Chiltern twin bored tunnels, with 48 cross passages, the

geotechnical baseline report, together with the Durability Report and Tunnel Obstructions Assessment and Settlement and Potential Damage Assessment. Kurt Zeidler acts as the Project Director.

*Northern Line Extension, London Underground Ltd (LUL), London, UK (2016 – Present)*

This expansion of the Northern Line entails 2.9km of TBM running tunnels, along with the construction of two new underground stations at Nine Elms and Battersea. Two Step Plate Junctions (partially SCL and hand mining) are constructed, to connect to the Northern Line's existing loop tunnel at Kennington Station. SCL/NATM Overrun Tunnels under a building on pile foundations, cross passages, TBM launch and reception tunnels, ventilation shafts and new station cross passages to upgrade the existing Kennington Station add to the construction scope of Northern Line Extension. The vast majority of the underground structures are located in London Clay with the exception of some parts of the Step Plate Junctions, one of which is intersecting the Lambeth Group sediments with water saturated silt and sand (Harwich formation). GZ is carrying out the Independent Category III check for all non-TBM tunnels. The construction of the Step Plate Junctions beneath sensitive buildings and the building the Overrun Tunnels pose the prime challenge on the project team. Mr. Zeidler is the Independent Category III Check team lead.

*Paddington Bakerloo Line Link, London Underground Ltd (LUL), London UK, (2015 – 2016)*

The Bakerloo Line Link will connect the Crossrail station at Paddington with the London Underground Bakerloo Line station. The link will provide a dedicated pedestrian route enabling passengers, including persons of restricted mobility (PRMs), to interchange between Crossrail and the Bakerloo Line without having to cross the concourse of the Network Rail station. Mr Zeidler is Team Lead for the Independent Category III Check for the SCL and hand-mining works, including primary and secondary linings and tunnel intersection; Cast in-situ secondary lining within sprayed primary lining including inverts; Squarework passages and shaft; SGI Linings and PCC Linings

*Riyadh Metro Project, Package 1 (Lines 1 and 2), ArRiyadh Development Authority (ADA), Riyadh, Kingdom of Saudi Arabia (2013–present):* The Riyadh Project will provide six new Metro Lines in the City of Riyadh to form the backbone of the future Riyadh public transport network. Extending over a total length of approximately 38km, Line 1 features TBM tunnels, that are approximately 17km long and 14 underground stations. Line 2, with its total length of approximately 22km features SCL/NATM tunnels with approximately 2km length and 3 underground stations. The Scope of Works for GZ Consultants included the Detailed Design and Site Supervision of two (2) TBM Launch Shafts and 13 Emergency Egress Shafts with adits and expert advice for the TBM drives for Line 1. The Line 2 Scope of Works included the Detailed Design and Site Supervision of 2km long mined tunnel, using the SCL/NATM technique, with primary and secondary lining, waterproofing and 2 Emergency Egress Shafts with Adit Tunnels. Mr Zeidler is Project Director for GZ Consultants.

Shotcrete permanent lining: Emergency Egress tunnels, Equipment rooms

*Vauxhall Station Upgrade Project, London Underground Limited (LUL), London, United Kingdom (2013-present):* The project consists of congestion relief and Step Free Access (SFA) works to improve passenger flow and accessibility for Vauxhall Station. A new SCL (NATM) shaft and tunnels were built to connect to the existing station ticket hall with the existing platforms. Geometrical constraints necessitated that the construction occurs within close proximity to existing station structures and underground platform tunnels, all of which were required to remain in full operation during the works. SCL/NATM Method was used in the geological formations of Thames Gravel and the London Clay. GZ provided the alternative and detailed design for the construction methods including primary ground support, waterproofing and secondary lining. Mr. Zeidler was GZ's project director and provided expert advice on geotechnical issues, tunnel construction, operational issues and design services for this project.

Shotcrete permanent lining: Lift shaft

*Northern Line Extension Tender, London Underground Ltd, London (LUL), United Kingdom (2013-2014):* This project saw the expansion of the Northern Line with 2.9 km of planned tunnels, along with the construction of two new LU stations at Nine Elms and Battersea. A step plate junction (SCL/NATM) is also planned, to connect to the Northern Line's existing loop tunnel. Mr. Zeidler acted as chief consultant to the joint venture, specialising in all aspects of SCL/NATM tunnelling.

*Bank Station Upgrade, London Underground Ltd (LUL), London, United Kingdom (2012-2014):* London Underground Ltd. carried out a major upgrade for the existing Bank Station including: a deep, large diameter lift shaft; escalator tunnels; running tunnels; a new station platform tunnel; cross passages and passenger tunnels that had to be constructed in the vicinity of three existing, operational underground station schemes. Above ground, highly sensitive buildings had to be protected against ground movements generated by the tunnelling works. The tunnels were constructed in London Clay using SCL (NATM) and traditional hand-mining techniques. Mr. Zeidler provided expert advice on constructability issues, tunnel construction proposals, programming, ground movement and building protection and contractors' proposals for this project.

*Den Chai to Chiang Rai Railway Line, State Railway of Thailand, Thailand (2011-present):* The State Railway of Thailand plans to construct an approximately 250 km long, new railway line in the northern provinces of Thailand. Four single-track, twin tunnels of a total length of approximately 15 km will be built along the alignment. The geological conditions vary from good quality igneous rocks to poor sedimentary rocks, residual soil, and soil and land slide areas. The tunnels are planned to be constructed using SCL/NATM and TBM methods. Mr. Zeidler provided expert advice on geotechnical issues, tunnel construction, operational issues and design services for this project.

*Bond Street Station Capacity Upgrade, London Underground Ltd (LUL), London, United Kingdom (2011-2015):* London Underground Ltd. undertook a major upgrade programme to improve the capacity and safety of the Bond Street station. Numerous passenger tunnels, stair-tunnels, escalator and lift shafts were built between and below existing underground facilities currently serving the underground station and major utility forming arteries for water, gas, power and communication. Above the construction site, a series of sensitive buildings had to be protected against the settlements caused by tunnelling activities. The majority of the tunnels were located in London Clay (highly over-consolidated clay) with the deepest tunnels intersecting the Lambeth Group sediments (over-consolidated clay, sand lenses, potential for pressurised groundwater). SCL (NATM) and traditional hand mining techniques were used. Mr. Zeidler was the team leader for the independent design check (Category III) services for all underground structures, including an impact assessment for existing above and below ground structures.

*Tottenham Court Road Station Upgrade, London Underground Limited, London, United Kingdom (2008-2011):* The upgrade consisted of a new concourse tunnel, escape tunnels, cross passages, interchange tunnels, connector stubs, and shafts. Mr. Zeidler led the Category 3 Independent Design Check of the Sprayed Concrete Lining (SCL) for the project. The independent check included the review of design drawings and checking the structural stability of the tunnels using Finite Element Analysis.

*Trans Hudson Express (THE) Tunnels, New Jersey Transit, Newark, New Jersey, to New York, New York (2006-2010):* New railway tunnel and terminus station in Manhattan and two new 1.5-mile long tunnels under the New Jersey Palisades and the Hudson River. Highly varied geological conditions (soft glacial lake deposits, estuarine deposits, hard Jurassic diabase, sandstone, and various hard rocks including Manhattan Schist). On the Manhattan side, soft soil and mixed face conditions required frozen soil techniques for pre-stabilisation and shotcrete linings for initial support of the TBM receiving tunnels and cross passages under the Hudson River. Mr. Zeidler and his team provided the design of the SCL/NATM tunnel segments, including a reception tunnel for the Hudson TBM drive in Manhattan and the cross-passages between the main tunnel tubes beneath the Hudson River and the rock caverns for the terminal station in Manhattan and expert advice for the TBM drives.

*Green Park Station – Step-Free Access Project, London Underground Ltd, London, United Kingdom (2008-2009):* London Underground carried out an upgrade project for the existing Green Park Station to provide Step Free Access. The project included the construction of a 28m deep, large-diameter shaft in close vicinity of an operational escalator shaft with new connections to existing platform tunnels and a large-span tunnel to accommodate the two-storey lift lobby. The new facilities were constructed in London Clay using SCL (NATM) techniques. Mr. Zeidler provided design services for the detailed design and tender documents.

*Victoria Station Upgrade, London Underground Ltd, London, United Kingdom (2007-2011):* Upgrade programme to improve the passenger accessibility and flow for two existing underground stations. The contract included the development of the reference design, specifications and detailed design for SCL/NATM passenger link tunnels, SCL/NATM escalator tunnels, SCL/NATM underground machine rooms and an access shaft using steel fibre reinforced shotcrete for initial tunnel support. The majority of the shallow tunnels were located in gravel, sandy gravel and sand while the deeper tunnels were located in London Clay. An extensive jet grouting scheme was implemented for gravel pre-stabilisation around the shallow tunnels. Mr Zeidler provided expert advice on tunnel design, ground stabilisation and contractual issues including support during the planning period.

*Crossrail Project, MDC3 and CI21, Transport for London, London, United Kingdom (2006-present):* Underground railway scheme crossing under the city of London. The contract includes the development of the reference design for 5 underground stations, 4 turn-outs and several ventilation/intervention shafts and adits as well as TBM driven running tunnels and 14 km of SCL (NATM) tunnels. Ground conditions include fill, Terrace Gravels and alluvium (gravels, sands, silts and clays), London Clay, and various deposits of the Lambeth Group (sands, silts and clays). The groundwater table is located above the tunnel roof elevations. Mr. Zeidler acted as the SCL/NATM Specialty Design Advisor and was responsible for the development of excavation and support design for SCL/NATM tunnels and shafts, ground pre-support and stabilisation, including excavation sequences and tunnel waterproofing. Mr. Zeidler was also on the Design Challenge Team.

Shotcrete permanent lining: All SCL station tunnels/caverns, ventilation tunnels, track bifurcations

*Beacon Hill Station, Sound Transit, Seattle, Washington (2006-2007):* Underground station scheme consisting of TBM (EPBM) segmentally lined running tunnels and SCL/NATM station caverns in soft ground using steel fibre reinforced shotcrete and mesh reinforcement. Mr. Zeidler and his team provided consultancy and construction design services for the contractor for TBM break-through situations, TBM launch facilities at the portal and within the station tunnels, excavation and support design for inclined ventilation tunnels and connections.

*Dulles Corridor Metrorail Project, Virginia Department of Rail and Public Transportation and Metropolitan Washington Airports Authority, Vienna, Virginia (2004-2012):* GZ provided the PE design of two (2) running tunnels in soft ground under shallow cover using SCL/NATM (steel fibre reinforced shotcrete, lattice girders and staged excavation sequence) and systematic pre-support, underground station design in soft rock at the airport main terminal, with two (2) station platform caverns, machine rooms and ventilation shafts and TBM running tunnel design. GZ provided the detailed design and construction design as well as site supervision, quality assurance and other site support during construction. Mr. Zeidler acted as tunnel discipline lead engineer for preliminary and detailed design and expert advice on tunnel pre-support installation.

*King's Cross Station Redevelopment, London Underground Ltd, London, United Kingdom (2002-2008):* The King's Cross Station Redevelopment included a new pedestrian link, escalator and concourse tunnels above and between three historic London Underground stations. Sprayed Concrete Lining / New Austrian Tunnelling Method (SCL / NATM) techniques were used for the tunnel construction, which took place in shallow cover beneath an active railroad and historic buildings. Ground conditions included fill, London Clay and the clays of the Lambeth Group; the groundwater table lies above the tunnel roof. Mr. Zeidler provided an independent review of excavation and support systems proposed by contractor

and designer; consultancy for waterproofing and permanent lining; support for contractual and technical decisions and expert advice. Forming part of the Client's assurance team, GZ also provided site support services on all SCL/NATM tunnels (steel fibre reinforced sprayed concrete, Laser Shell<sup>®</sup> method, tunnel connections and interfaces).

Shotcrete permanent lining: Pedestrian tunnels

*No. 7 Subway Line Extension, New York Metropolitan Transportation Authority Capital Construction (MTACC), New York, New York (2002-2003):* Once completed, the No. 7 Subway (Flushing) Line Extension extended the service beyond Times Square West along 41st Street and south along 11th Avenue, terminating in the vicinity of 25th Street / 11th Avenue. The extension included twin TBM running tunnels with five cross passages, a 34th Street Station cavern, three shafts, and numerous ancillary structures. Mr. Zeidler was involved in the development of conceptual design for construction methods for running tunnels including access tunnels, TBM assembly / disassembly chambers and station caverns / tunnels, shafts in rock and TBM selection and TBM tunnel support.

*East Side Access Project, New York Metropolitan Transportation Authority Capital Construction (MTACC), New York, New York (2001-present):* East Side Access (ESA) is one of the most complex, ongoing transportation projects in the United States. The project will connect the Long Island Rail Road's (LIRR) Main and Port Washington lines in Queens to a new LIRR terminal beneath Grand Central Terminal (GCT) in Manhattan. The new connection will increase the LIRR's capacity into Manhattan and dramatically shorten travel time for Long Island and eastern Queens commuters travelling to the East Side of Manhattan. Mr. Zeidler was a consultant for design of geotechnical and structural instrumentation of existing and new tunnels in Manhattan schist as well as utilities and high-rise buildings along the tunnel alignment and the station caverns. GZ's scope also included the design services for the underpass under the Northern Boulevard in Queens including design and expert advice on construction sequence, excavation and support sequence and ground freezing. Mr. Zeidler provided design services, numerical analyses services, review and expert advice.

Shotcrete permanent lining: Station tunnels, running tunnels

*Barrington Road Ventilation Shaft, Channel Tunnel Rail Link (CTRL), Ilford, United Kingdom (2000):* This project consisted of the construction of a 125ft (38 metre) deep shaft designed to retrieve two Tunnel Boring Machines (TBMs), as well as serve as a permanent ventilation shaft. The cross section of the shaft measured 36 x 40ft (11 x 12 meters) at the bottom, and 34ft (10.2 meters) at the top. Ground conditions included fill, alluvium, Terrace Gravels, London Clay, and the Harwich and Reading formations. Mr. Zeidler and his team acted as consultant for independent category 2 design check services, including: assessment of ground conditions, intermediate construction stages, final stage of the structure in relation to ground deformation, structural integrity of the upper sheet piled wall and sprayed concrete lining.

*Athens Metro, Ambelokipi Station, Ministry of Infrastructures, Transport and Networks, Athens, Greece (1995):* Mr. Zeidler was a consultant providing advice to the owner on the construction methods being used and proposed by the contractor to build three (3) station tunnels in soft rock.

*Athens Metro, Monastiraki Station, Ministry of Infrastructures, Transport and Networks, Athens, Greece (1997):* Mr. Zeidler was a consultant providing advice to the owner on the construction methods being used and proposed by the contractor to build three (3) station tunnels in soft rock.

*Channel Tunnel Rail Link, CTRL, London, United Kingdom (2000):* Mr. Zeidler acted as the technical director responsible for alternative designs for tender purposes for contracts 330 and 410 in chalk and soil.

*Jubilee Line Extension, Contract 103 & 104 – London Bridge Station, London Underground Ltd, London, United Kingdom (1993-1997):* Mr. Zeidler was the Project Manager responsible for design and construction supervision of all SCL/NATM work (steel fibre reinforced and mesh reinforced shotcrete with lattice girders initial support, staged excavation sequence) including tunnels of between 4.8 to 12.0m span, 11m diameter shafts and all junctions in London clay;

fire, life & safety issues.

Shotcrete permanent lining: Ventilation tunnels, track bifurcation

*Washington Metro, Sections F6b, E4a & b, Washington Metropolitan Area Transit Authority (WMATA), Washington, D.C. (1994-1997):* Mr. Zeidler was the technical director responsible for SCL/NATM detailed design and waterproofing. Review of designs and directing site supervision (E4b). In addition, he was the geotechnical manager for all works including dewatering in sand and tunnelling in clay and dewatered sand.

*South Boston Transitway, Russia Wharf Segment, Massachusetts Bay Transit Authority (MBTA), Boston, Massachusetts (1998):* Ground conditions included soft ground, marine clay, woodpiles with minimal cover to ground level and building foundations. Mr. Zeidler acted as technical director and project manager responsible for light railway/bus tunnel design (feasibility study, detailed design, tender documents), involving SCL/NATM methods, underpinning, ground freezing and waterproofing.

*Crossrail Project, Crossrail London Rail Links, Ltd., London, United Kingdom (1991 - 1994):* Crossrail includes a total of 12.5 miles (20 kilometers) of tunnels and 7 underground stations that will connect London's West End and Docklands to Heathrow Airport with existing railway lines that extend east, west and southeast from the city. Ground conditions include fill, Terrace Gravels and alluvium (gravels, sands, silts and clays), London Clay, and various deposits of the Lambeth Group (sands, silts and clays). The groundwater table is located above the tunnel roof elevations. Mr. Zeidler was technical director and project manager responsible for consultancy and value engineering regarding SCL/NATM construction of underground railway stations in London clay in an urban environment.

*Heathrow Express Rail Link, Trial Tunnel, British Airport Authority, London, United Kingdom (1991-1992):* Mr. Zeidler acted as Deputy Project Manager for design of SCL/NATM trial tunnelling works in soft ground (London clay).

*Heathrow Express Rail Link, Terminal 1, Terminal 4, British Airport Authority, London, United Kingdom (1991-1992):* Mr. Zeidler acted as Deputy Project Manager for tender bid design of SCL/NATM station tunnelling works in soft ground (London clay).

*Eichbergtunnel, Deutsche Bundesbahn, Frankfurt, Germany (1981):* Mr. Zeidler was technical assistant for design of SCL/NATM drill and blast tunnelling in Bunter sandstone.

## **Road Tunnels**

*Silvertown Tunnel, London, UK (2021 – ongoing):* The Silvertown Tunnel is a new approximately 1.4 km long twin bored TBM road tunnel with 7 cross passages, located in East London crossing beneath the River Thames. It will connect the Greenwich Peninsula to Silvertown. The alignment for the tunnels and cross passages passes through the geological sequence of Made Ground, Alluvium, River Terrace deposits, London Clay, Harwich Formation, and the sedimentary series of the Lambeth Group. With one exception, all cross passages pass through the lower London Clay, Harwich Formation (cohesive and granular) and Lambeth Group sediments. 5 of the 7 cross passages are planned to be built using artificial ground freezing, sprayed concrete as primary lining, waterproofing and reinforced concrete secondary lining.

GZ consultants are responsible for the ground freezing design, design of the opening sets in the TBM tunnels and the cross passage design. Kurt Zeidler acts as the Project Director for GZ consultants.

*Zimmerman Trail Tunnel Project, City of Billings, Billings, Montana (2010-2011):* Zimmerman Trail is a historic road that was originally constructed in the late 1800's for the purpose of expediting livestock. A tunnel has been proposed to eliminate the concern of the unstable slope adjacent the road. The proposed road tunnel will consist of 14-ft (4.2m) lanes with 8-ft (2.4m) shoulders for bidirectional traffic. Excavation through the rock will be done utilising the sequential excavation method (SEM) with controlled blasting. Tunnel ground support will include rock dowels and reinforced shotcrete. After excavation and support was completed, a waterproofing membrane was installed on the roof and sidewalls creating a drained system

followed by a cast-in-place reinforced concrete final lining. Kurt Zeidler was the project manager for the design team providing conceptual design of tunnel layouts, alignment and construction methods.

*Kathu-Patong New Highway Linkage Project, Municipality of Patong, Expressway Authority of Thailand, Phuket Island, Thailand (2009-2013):* This project included the construction of twin dual-lane highway tunnels connecting the cities of Kathu and Patong on the island of Phuket, as well as tunnel cross passages, portals and approach structures. The tunnels replaced the existing windy, narrow and steep road, which gave rise to repeated severe road accidents. In addition, heavy motorbike traffic as well as utilities for local water, power and communication supplies were accommodated within the tunnels. Ground conditions included massive, highly-tectonised and weathered granites, residual soils, colluvial materials, and sedimentary rocks. Mr. Zeidler was responsible for the development of conceptual tunnelling methods, tunnel cross sections and portal as well as approach structures.

*Caldecott Tunnel Improvement Project, Contra Costa Transportation Authority / CALTRANS, Oakland, California (2008-2013):* The existing Caldecott Tunnel consisted of three two-lane tunnels that connect Alameda and Contra Costa counties via State Route 24 (SR-24). In order to reduce traffic congestion and delays, the project included the construction of a fourth tunnel with seven cross passages to one of the existing tunnels using the New Austrian Tunnelling Method (NATM). Excavation through the harder rock sections were done utilising controlled blasting and tunnel ground support which included rock bolts and shotcrete. After the excavation was finalised, a waterproofing membrane was installed on the roof and sidewalls followed by a cast-in-place reinforced concrete final lining. Mr Zeidler provided expert advice on constructability, contractor's submittals and ground conditions.

*Sentosa Gateway to Kampong Bahru Road / Keppel Road, Singapore Land Transport Authority, Singapore (2009-2013):* Sentosa Gateway provides a new vehicular underground connection to divert car traffic around the busy area of the Singapore Port. The project entails ramp structures, cut and cover tunnels and two mined sections crossing under multiple lane roads. Mr. Zeidler led the conceptual and detailed design including development of contract documents for the two mined tunnels using pipe-box techniques and SCL/NATM with systematic pre-support.

*Devil's Slide Tunnels, CALTRANS, San Pedro Mountain, US Highway 1 between Half-moon Bay and Pacifica, California (2006-2010):* The tunnels bypass US Highway 1 in an area prone to landslides. SCL/NATM was used with five different support categories including fibre-reinforced shotcrete, rock reinforcement and pre-support elements including pipe arch canopies. Mr. Zeidler and his team provided integrated on-site SCL/NATM consulting services to the contractor, shop drawings for excavation and support sequences, portal canopy, waterproofing and final linings, ground structure interaction (FE) analyses, and evaluation of SCL/NATM instrumentation and monitoring results.

*Fort Canning Tunnel and Realignment of Stamford Road, Singapore Land Transport Authority, Singapore (2004-2006):* The project consisted of a SCL/NATM design that utilised a two pass lining system for the mined portion of proposed tunnel in soft ground under shallow cover. GZ provided detailed design of construction methods to the Contractor, an effort which was led by Kurt Zeidler.

*Dublin Port Tunnel, National Roads Authority (Dublin City Council), Dublin, Ireland (1998-1999):* Two large TBMs, a hardrock-TBM and a shield machine of nearly 12m diameter were used in different kinds of Irish Boulder Clay and argillaceous limestone. Launch of the TBMs was from a 40 m diameter shaft. Mr. Zeidler was a member of the Design Compliance Team for TBM drifts and SCL/NATM constructions on lining and waterproofing, groundwater management and surface settlements.

*Gräberntunnel, ASFINAG, Carinthia, Austria (2000):* Mr. Zeidler provided the design of excavation and support for a road tunnel in rock, mylonite and faults for the A2.

*M5 East Motorway, Princes Highway Exit Ramp, NSW Transport Roads & Traffic Authority, Sydney, Australia (1999):* Mr. Zeidler carried out an independent design check of the detailed



design of the soft ground excavation and support.

*Egnatia Odos Project, Section 5.2, Egnatia Odos S.A., Greece (1999):* Mr. Zeidler carried out an independent design check for three road tunnels in rock, plus a review of the electrical and mechanical equipment design.

*Kohat Tunnel, National Highway Authority, Pakistan (1997):* Mr. Zeidler performed field inspection and tunnel design review for a two lane road tunnel in highly tectonically disturbed rocks including review and evaluation of tender document and evaluation of contractors' bids.

*Central Artery, Section 19, Contract E1, Massachusetts Bay Transportation Authority (MBTA), Boston, Massachusetts (1997):* Mr. Zeidler acted as Technical Director, and was responsible for the detailed design of 33ft (10m) to 51ft (15.5m) span road tunnels in alluvial and marine soils in an urban area.

*Central Artery, Section C11, Contract A1, Massachusetts Bay Transportation Authority (MBTA), Boston, Massachusetts (1997):* Mr. Zeidler acted as Technical Director, and was responsible for the detailed design of 33ft (10m) to 51ft (15.5) span road tunnels in alluvial and marine soils in an urban area.

*Ramsgate Tunnel, Ramsgate Olympia, Ramsgate, United Kingdom (1995):* Mr. Zeidler acted as Technical Director, and was responsible for SCL/NATM tunnel design and waterproofing including doorframe slab and portal canopy design. Ground conditions included made ground and upper chalk.

*Kaohsiung-Pingtung Highway Tunnel, Taiwan Railways Administration, Taiwan, Republic of China (1992-1993):* Mr. Zeidler was Geotechnical Manager, responsible for design of twin tunnels in soft rock, claystone, sandstone and mylonite, using SCL/NATM and doorframe slab method.

*Addison Airport Highway Tunnel, City of Addison, Dallas, Texas (1992-1993):* Mr. Zeidler was Geotechnical Manager for a SCL/NATM tunnel design in soft ground and chalk.

*Southwick Hill Highway Tunnel, Department of Environment and Transport, West Sussex, United Kingdom (1990):* Mr. Zeidler acted as consultant for SCL/NATM work for tunnel construction in the upper chalk.

*Schürzeberg Tunnel, Germany (1990-1992):* Mr. Zeidler was resident engineer, whose duties included construction supervision and leading the supervision team as well as claims defense regarding SCL/NATM tunnels, barrel vault method and doorframe slab method in Bunter sandstone, soft ground, tunnelling through a railway embankment (rock fill, sand, silt, high porosity); construction supervision for installation of electrical and mechanical equipment, supervision of test operations for air monitoring, ventilation and emergency response system.

*Haberbergtunnel, ASFINAG, Austria (1988-1989):* Mr. Zeidler was the Geotechnical engineer on site, responsible for ground classification for SCL/NATM tunnelling and monitoring in soft ground and rock.

*Kollmanntunnel, ASFINAG, Austria (1988-1989):* SCL/NATM tunnelling using drill and blast and backhoe excavation in sandstone, schist, phyllite soft rock, mylonite with swelling clay, fine sand. Mr. Zeidler was the Geotechnical engineer on site. His responsibilities included engineering geological mapping, rock mass classification and selection of support system, documentation and geotechnical instrumentation, monitoring, and interpretation and claim defense.

*Karawankentunnel, ASFINAG, Austria (1987-1988):* SCL/NATM tunnelling using drill and blast in hard rock, soft rock and backhoe in mylonite and swelling clay; large water ingress and water in-rush. Mr. Zeidler was the Geotechnical engineer on site; his responsibilities included engineering geological mapping, rock mass classification, definition of the support system and installation supervision and documentation.

*Massenberg Tunnel, ASFINAG, Austria (1984-1985):* Mr. Zeidler acted as Geologist on this project, his duties included: Engineering geological mapping, rock mass classification and selection of support system, as well as documentation for SCL/NATM tunnelling using drill and blast in green schist, soft ground.

*St. Ruprechter Highway Tunnel, ASFINAG, Austria (1984-1985):* Ground conditions included phyllite, swelling clay, graphite, mylonite. Mr. Zeidler acted as Geologist on this project, his duties included: Engineering geological mapping, rock mass classification and selection of support system, and documentation for SCL/NATM tunnelling using drill and blast and backhoe, as well as repair of massive sliding slope at the portal.

*Brucker Highway Tunnel, ASFINAG, Austria (1984-1985):* Mr. Zeidler acted as Geologist on this project, his duties included: Engineering geological mapping, rock mass classification and selection of support system, documentation for SCL/NATM drill and blast tunnelling in mylonite, clay, phyllite, swelling clay and graphite.

*Kroislerwandtunnel, ASFINAG, Austria (1984):* Mr. Zeidler acted as Geologist on this project, his duties included: Engineering geological mapping, rock mass classification and selection of support system, documentation for SCL/NATM drill and blast tunnelling in dolomite.

*Wolfsbergtunnel, ASFINAG, Austria (1983):* Mr. Zeidler acted as Geologist on this project, his duties included: Engineering geological mapping, rock mass classification and selection of support system, documentation for SCL/NATM drill and blast tunnelling in schist and quartzite.

*Kherrata Highway Tunnels, Ministry of Transport (MPW), Algeria (1982):*

Mr. Zeidler acted as Consultant for SCL/NATM works in carbonates (limestone and dolomite).

### **Tunnel Rehabilitation/Refurbishment/Repair**

*Farnworth Tunnel Rehabilitation, Network Rail, UK (2014 – 2015):* The rehabilitation and reconstruction project entailed ground treatment, secant piling, sprayed concrete, steel arches and open face TBM excavation with segmental lining. The “Up” Tunnel was filled with low strength concrete and re-mined using 9m DIA open face shield to construct a new, 8m diameter segmental lined tunnel whilst ongoing train traffic was diverted through the re-lined “Down” Tunnel. GZ provided the independent design check (Cat. III) services for the entire project and related slope supports. Kurt Zeidler acted as the checking team leader.

*Weehawken Tunnel, New Jersey Transit Authority Hudson Bergen Light Rail Transit, North Bergen, New Jersey (2003-2005):* Rehabilitation, enlargement and relining of an existing railway tunnel and construction of a light railway underground station using drill and blast excavation, rock dowels, shotcrete support, membrane waterproofing, cast-in-situ concrete and shotcrete permanent lining. Soil nail wall and slope supports at portals and tunnel approaches. Design of permanent tunnel support, portal wall and slope support. Kurt Zeidler was responsible for checking the permanent tunnel support and waterproofing design and the detailed design of the soil slope support (soil nail walls and gravity walls).

Shotcrete permanent lining: Running tunnels, transitions, station tunnels

*NYCT Ventilation Building, New York Metropolitan Transit Authority (MTA), New York, New York (2002-2003):* Mr. Zeidler acted as Consultant for waterproofing repair for underground ventilation structure using chemical grout; plus, design and site supervision.

*PATH Tunnels Rehabilitation & Exchange Place Station Improvement Project, New York Metropolitan Transit Authority (MTA), New York, New York (2002-2003):* Mr. Zeidler acted as Consultant for construction ventilation.

*Bergen Tunnels Rehabilitation, New Jersey Transit Authority Hudson Bergen Light Rail Transit, Bergen, New Jersey (2001-2002):* Mr. Zeidler was Consultant to the contractor for excavation and support as well as construction staging in rock, construction ventilation, ventilation considerations in relation to tunnel reconstruction and ventilation shaft configurations.

*Berry Street Tunnel, Owner, Pittsburgh, Pennsylvania (1996-1997):* Design included waterproofing, permanent tunnel lining and a portal canopy. Mr. Zeidler was the Technical

Director, responsible for rehabilitation design, including enlargement of an existing brick-lined tunnel in claystone, sandstone and backfill of cavities.

*East London Line Thames Tunnel (Brunel's Tunnel) Refurbishment, Network Rail & Transport for London (TfL), London, United Kingdom (1995-1996):* Mr. Zeidler was the technical director and project director responsible for flood mitigation protection measures including tunnel refurbishment, waterproofing and sprayed and cast in-situ concrete lining.

## **Power Tunnels**

*Shuakhevi Hydro Power Project, Adjaristsqali Georgia Limited (AGL), Georgia (2018 – Present):* The Shuakhevi HPP is a hydropower project currently under construction in Adjara, Georgia. The scheme comprises two Powerhouses, three dams and weirs and tunnels (4m and 5.15m span) to transfer water between reservoirs (6.25km 9.2km), a long headrace tunnel (16.6km, 6.22m span) to the main Powerhouse, a 250m high 6.4m diameter vertical Pressure shaft (6.4m DIA), an 800m long high-pressure headrace tunnel and a 500m long, 3.25m DIA steel lined penstock. The tunnels pass through a volcanic sediment series consisting of basalts, andesites, ashes and mudflow sediments and breccias, partially highly impacted by tectonics, slickensides and fault gauges. GZ is involved in the root cause analyses and rehabilitation of tunnel instabilities along the various tunnels. Kurt Zeidler acts as the lead on the root cause investigation and independent Peer Reviewer for the rehabilitation works.

Shotcrete permanent lining: Sections of the headrace tunnels, pressure shaft

*London Power Tunnels, National Grid, London, United Kingdom (2011-2014):* Mr. Zeidler performed an independent design check for three access shafts with shotcrete single-pass lining and interfaces with TBM tunnels. Furthermore, he provided the primary and secondary lining design for TBM launch adits, reception adits, and cable diversion chambers in London Clay and Lambeth Group geology.

Shotcrete permanent lining: Junction chambers, cable adit tunnels

*Singapore Power Tunnels (2011 - 2015):* Singapore Power commissioned the construction of two major power transmission cable tunnels (North-South and East-West tunnels) as part of their extensive network. The North-South Transmission Cable Tunnel is 18.5km long, running from Gambas to May Road, designed for storage ten 400kV electrical cable, and constructed in three contracts. Contract NS1 comprises the northern contract running from Gambas Shaft to Mandai Shaft. The works in this Contract consist of a 5.87km TBM tunnel with an internal diameter of 6m and three Shafts, namely Gambas Shaft, Sembawang Shaft and Mandai Shaft tunnel adits at these shaft location and junction chambers. GZ were retained to provide the detailed design for all rock junction chambers and shafts by the contracting JV. Mr. Zeidler was the designer of records and lead the design team.

*Godar-E-Landar Hydroelectric Scheme, AB VA NIROO Iran Water & Power Resources Development Company, Iran (1993-1994):* Ground conditions included conglomerate, siltstone, sandstone and mudstone. Mr. Zeidler acted as consultant on claims caused by changed site conditions in tunnels and instability of high portal slopes. Drill and blast for slope excavation and SCL/NATM tunnelling.

*Messochora power tunnel, Ministry for the Environment, Physical Planning and Public Works (MEPPPW), Greece (1993):* Mr. Zeidler acted as Consultant to the Owner regarding ground conditions and TBM tunnelling to construct a diversion tunnel in soft rock, limestone.

*Habachtal Hydroelectric Power Scheme, SAFE, Austria (1993-1994):* Mr. Zeidler was Geotechnical Consultant to the contractor for TBM drives in schist, mylonite, phyllite, graphite. Study on TBM / ground relevant parameters.

*Soboth Hydroelectric Power Project, Verbund, Austria (1987):* Mr. Zeidler was Geotechnical consultant for TBM drives in schist, quartzite.

## **Other Facilities**

*Highspeed 2 Enabling Works Batch 1, Birmingham Sewer Diversions, UK (2020 – present):*  
The construction of a new viaduct for the Highspeed 2 Project, Phase 1, the diversion of four sewer lines are required (Erskine Street, South of Duddleston Mill Road, North of Duddleston Mill Road and Saltley Viaduct). The new sewers will be installed using trenchless (pipe jacking) and open trench methods. GZ are the designers for the pipe jacking sections and temporary as well as permanent shaft construction. This includes pipes of 1500mm ID to 2700mm ID, caisson shafts (wet method jacked caissons) of 7.5m to 12.5m ID and sheet pile cofferdams. Kurt Zeidler acts as the Project Director.

*Queen Elizabeth II Reservoir, Relining of Inlet and Outlet Tunnels, UK (2021):*  
The existing wedge-block lined raw water Inlet (1060m) and Outlet (795m) tunnels with approximately 5m DIA will be relined with a reinforced cast-in-situ concrete lining. The project also includes the construction of two temporary access shafts with 6m DIA constructed as segmentally lined caissons (jacking and underpinning). GZ are carrying out the independent Category III design checking of the tunnel relining and temporary access shaft construction. Kurt Zeidler acts as Checking Team Leader.

*Guinea Alumina – Port Area – Car Dumper excavation, Guinea Alumina Corporation, Kamsar, Guinea (2018 – present):*  
The Car Dumper excavation takes place in young coastal sediments consisting of mixed layers of sand, silt and clay deposits. The sediments directly below the excavation contain pressurised groundwater. During the excavation instabilities of the excavation base and slopes occurred. GZ act as the independent Engineer for the Client. Kurt Zeidler acts as independent lead engineer for the rehabilitation works.

*Kosovo Route 6 Motorway Project, Section C3, Bechtel, Kosovo (2017 – present):*  
The alignment for the highway project cuts through a series of valleys and slope. The geological strata exposed during the excavation works include recent talus, water saturated residual soils (chaotic mixture of clay, silty clay, sandy clay, rock fragments in clayey matrix) from shists with layers of marble and gneiss. The shists contain high amounts of mica. Natural slope instabilities along the alignment are frequent and require significant stabilisation measures for cuts and bridge foundations. GZ act as independent design reviewer. Kurt Zeidler acts as expert advisor for slope stabilisation and implementation.

*NEWater Infrastructure Plan Extension (NIPE) NIPE Contract C4, Singapore Public Utilities Board, Singapore (2010):* Tender Design for approximately 3,255 m long, combined sewer and water tunnel with 6.75 m ID from Jurong Island to Gul Road/ Pioneer Road Junction. The tunnel is located in weathered to decomposed rock and residual soil passing under West Jurong Channel with high groundwater head. Mr. Zeidler provided preliminary pre-cast segmental lining design and specification of TBM, assessment of tunnel face pressure, preliminary design of launch and reception shaft including ground modifications and preliminary design of surface/subsurface instrumentation.

*Automated People Mover System, Washington Dulles International Airport, Dulles, Virginia (2000):* GZ provided initial peer review and subsequent construction management services for the IAD APM System. These services included design review and construction inspection related to the underground aspects of the work, New Austrian Tunnelling Method / Tunnel Boring Machine (NATM / TBM) tunnel excavation and support, instrumentation and monitoring, waterproofing, support of excavation for cut-and-cover construction for station and lined tunnels and the installation of electrical and mechanical systems for the facilities. Mr. Zeidler was member of the checking and advisory team during construction.

*Pedestrian Walkback Tunnel, Washington Dulles International Airport, Dulles, Virginia (2000):* Mr. Zeidler provided design of excavation and support, contract documents, detailed design, fire, life and safety considerations for ventilation scheme arrangements, emergency escape and access ways, smoke extraction and cut-off facilities.

*Deep Tunnel Sewerage Project, Contract T02 and T05, Ministry of the Environment and Water Resources (PUB), Singapore (1999):* Tender design for SCL/NATM and TBM in rock and soil. Mr. Zeidler gave advice on TBM selection and face pressure, shaft design and TBM break-in.

*Karl-Glössing-Straße Sewer Project, Town of Wiesbaden, Wiesbaden, Germany (1991):* Mr. Zeidler acted as Project manager for a feasibility study and SCL/NATM tunnel design in soft ground, peat and groundwater.

*Taunusstraße Combined Stormwater and Sewer Retention Basin, Town of Weisbaden, Wiesbaden, Germany (1990):* Mr. Zeidler was the Resident engineer/project manager for investigation and feasibility study regarding TBM drives, slurry walls and concrete slabs in schist, soft ground and artesian thermal water construction ventilation considerations.

*Lindbergh Boulevard Tunnel - St. Louis International Airport, St. Louis Airport Authority, St. Louis, Missouri, USA (2000):* Mr. Zeidler acted as Consultant for the review of the design of operational ventilation scheme.

*Falkirk Canal Tunnel, Millennium Commission, Scotland, United Kingdom (2000):* Mr. Zeidler provided design and consultancy for the excavation and support.

*Bluewater Quarry Haulage Tunnels, Lend Lease (land owned by Blue Circle), Kent, United Kingdom (1995-1996):* Mr. Zeidler acted as Technical director, responsible for design and construction supervision of SCL/NATM non-circular, 7.5m span, tunnels in jointed chalk (weak limestone).

*Achberg Pilot Tunnel, AMT Der Salzburger Landesregierung, Austria (1989-1990):* Mr. Zeidler acted as Geotechnical engineer: Project study for SCL/NATM drill and blast tunnel construction in claystone, gypsum, mylonite swelling clay, sandstone. Geotechnical instrumentation, long-term observation.

*Gossensass, Pilot Tunnel, Italian Railway Authority, Italy (1986-1987):* Mr. Zeidler acted as Geotechnical Consultant to the contractor regarding a TBM drive in schist, crushed (cataclastic) dolomite, mylonite. Study on TBM/ground relevant parameters.

*Crossrail Project, Transport for London, London (TfL), United Kingdom (1991):* Mr. Zeidler is a member of the "Challenge Team" providing technical expert review services regarding the construction of the underground railway stations in London clay, in an urban environment.

*Shepherd's Bush Station Upgrade, London Underground Limited (LUL), London, United Kingdom (2004-2006):* Mr. Zeidler was an expert Consultant to the owner for upgrade program involving new passenger tunnels above and between existing SGI station tunnels. The design included steel fibre reinforced sprayed concrete, water proofing, concrete lining, mass-grouting, soft ground (London Clay).

## **Expert Services**

Independent Risk Engineer for Swiss RE: *Caravanke Tunnel South, second bore, Slovenia, (2021 – present)*

Independent Risk Engineer for Swiss RE: *Bane Nor, for projects Sandbukta-Moss-Såstad, Utbygging Drammen-Kobbervikdalen, Utbygging Nykirke-Barkåker, Norway (2021 – present)*

Independent Risk Engineer for Swiss RE: *Brenner Base Tunnel, Austria (2020 – present)*

Independent Expert Peer Review: *Shuakevi Hydro Power Project, Georgia* on multiple tunnel instabilities.

Independent Expert Services: *Kosovo Route 6 Motorway Project, Section C3, Kosovo* on slope instabilities, (2017 – present).

Expert Witness Services: *Crossrail, Shotcrete Fallout Incident Crossrail, UK; (2017)*, Mr. Zeidler provided Expert Advisory & Witness Services.

Expert Witness Services: *Transmission Cable Tunnel ("Powergrid Tunnel") from Harbour Drive to Labrado, Singapore; (2011)*, Mr. Zeidler was called upon to provide Expert Witness Services and Litigation Expert Witness Services for arbitration proceedings

Technical Expert Services *Bunji Hydropower Project, Pakistan Water and Power Development Authority, Bunji, Pakistan (2008-2011)*: The Bunji Hydropower Project is a planned 6,000 MW facility to be constructed on the Indus River in Northern Pakistan. This massive undertaking will consist of at least 11 mined tunnels and powerhouse caverns. The tunnels traverse distances up to 8 kilometers and will run through a tectonically active region and a continental thrust fault. Mr. Zeidler was a member of the Expert Panel – Geotechnics and Tunnel/Cavern construction.

### **Technical Papers and Publications**

"MODERN URBAN TUNNELLING – RESPONDING TO SOCIAL NEEDS", 68<sup>th</sup> Geomechanics Colloquium Salzburg, Austria 10<sup>th</sup> & 11<sup>th</sup> October 2019 (with Vojtech Gall)

DESIGN AND CONSTRUCTION CHALLENGES IN URBAN SETTINGS FOR THE NATM TUNNELS LINE 2 OF THE RIYADH METRO, NAT 2018, Washington, D.C., June 24 – 27, 2018 (with Sandeep Pyakurel and Andreas Gerstgrasser)

"VAUXHALL STATION STEP FREE ACCESS", ITA Tunnelling Awards 2017, Winner of the ITA Tunnelling Award 2016, Category Tunnel Rehabilitation Projects, Singapore, November 11, 2016

"SOFT GROUND TO HARD ROCK – VERSATILE TUNNELLING METHODS IN URBAN AREAS". Symposium on Zagreb underground, Zagreb, Croatia, (with V. Gall & D. Reda), March, 27-28, 2014.

"MAKING SPACE IN URBAN AREAS – THE BOND STREET STATION UPGRADE PROJECT", 2012 World Tunnel Conference Proceedings, May 18-23, Bangkok, Thailand (with Grant, A. and McCann, D.)

"EXPERIENCE WITH SYNTHETIC FIBER REINFORCED INITIAL SHOTCRETE LINING AT THE DEVIL'S SLIDE TUNNEL PROJECT", Spritzbetontagung 2009 (Shotcrete Conference 2009), January 15-16, Alpach, Austria.

"FIBER REINFORCED SHOTCRETE FOR TUNNEL LININGS," FIRST INTERNATIONAL CONFERENCE ON ADVANCES IN CONCRETE Technology (RAC07), with J. Jaeger, Washington, D.C., 2007.

"FE MODELLING FOR THE SHALLOW FORT CANNING TUNNEL", EURTUNNEL 2007, September 23-29, (with Y.Ch.Hun), Vienna.

"PRE-SUPPORT MEASURES FOR SHALLOW NATM TUNNELING IN URBAN SETTINGS," NAT 2008, June 8-11, with V. Gall.

"MONITORING SUCCESSFUL NATM IN SINGAPORE", RETC 2007, June 10-13, Toronto, Proceedings (with T.Schwind).

"THE DULLES CORRIDOR METRORAIL AND ITS TUNNELING ASPECTS", 2007 World Tunnel Congress and 3rd ITA General Assembly, May 5-10 2007 (with V Gall and J Rudolf).

"NATM FOR SINGAPORE" – NAT 2006, June 10-15, Proceedings (with Thomas Schwind, and Vojtech Gall).

"SHOTCRETE CONSTRUCTED CUT AND COVER TUNNEL PORTAL", NAT 2006, June 10-15, Proceedings (with Leon Jacobs, and Anthony Murtha).

"SHOTCRETE FOR TUNNEL FINAL LININGS – DESIGN AND CONSTRUCTION CONSIDERATIONS", Seminar Proceedings, NAT 2004 Proceedings, North American Tunnelling Conference,

Atlanta, Georgia, April 17-22, 2004 (with Gall, V., Munfah, N. and Cerulli, D).

“BERGEN TUNNELS REHABILITATION – A SUCCESS AFTER ALL”, Seminar Proceedings, 2003 RETC Proceedings, Rapid Excavation and Tunnelling Conference, New Orleans, Louisiana, June 16-18, 2003 (with V. Gall, and Mergentime, St.).

“DESIGN CRITERIA FOR LARGE TUNNELS IN SOFT GROUND”. International Conference on Tunnels and Underground Structures, November 27-29, 2000, Singapore, Proceedings (With V.Gall).

“FROZEN GROUND AS BUILDING SUPPORT -IMPLEMENTATION OF INNOVATIVE ENGINEERING CONCEPTS FOR TUNNELING AT RUSSIA WHARF”. North American Tunneling Conference NAT 2000, June 6 - 11, Boston, USA (With others).

“CONSTRUCTION OF MISCELLANEOUS UNDERGROUND STRUCTURES FOR SUBWAY PROJECTS.” Underground Construction Congress, New York, USA (With others).

“SHOTCRETE LINING DESIGN CONCEPTS FOR NEW AND REHABILITATED TUNNELS”. Shotcrete for Underground Support VIII, April 11-15, 1999, Campos do Jordao, Brazil. (With V.Gall).

“ABOUT THE INFLUENCE OF COMPENSATION GROUTING ON SHOTCRETE TUNNEL LININGS AT LONDON BRIDGE STATION”. World Tunnel Congress 98, April 1998, Sao Paulo, Brazil.

“REHABILITATION CONCEPTS FOR BRICK LINED TUNNELS IN URBAN AREAS”. World Tunnel Congress 98, April 1998, Sao Paulo, Brazil. (With V. Gall, T. Predis & J. Walter).

“OPTIMIZATION OF TUNNEL PRE-SUPPORT - SOFT GROUND NATM AT WASHINGTON D.C. METRO SECTION F6B”. North American Tunneling 98, Feb 1998, pp 229-236, Newport Beach, CA. (With V. Gall, B. Myers Bohlke & L. Alfredson).

“SURFACE SETTLEMENT DUE TO THE CONSTRUCTION OF THE LONDON BRIDGE STATION TUNNELS BY NATM”. Proceedings World Tunnelling Conference, Vienna (1997). (With R. Allen, P. Groves & D. Sharrocks).

“LONDON BRIDGE STATION, JUBILEE LINE EXTENSION”. Proceedings RETC 1997, June 22-26, Las Vegas, Nevada (with V. Gall).

“THE DOORFRAME SLAB METHOD, BARREL VAULT METHOD AND CONVENTIONAL NATM APPLIED AT THE BY-PASS AT OBERRIEDEN, GERMANY”. 1993 RETC Proceedings (chapter 20, page 325-340), Boston, Massachusetts, June 13-17, 1993 (with G. Sauer and V. Gall).

“DER SCHÜRZBERGTUNNEL OBERRIEDEN”. Tunnel International Journal for Subsurface Use, Official Journal of the STUVA, 3rd quarter 1992, page 58-64, Cologne (1992).

“DER SCHÜRZBERGTUNNEL OBERRIEDEN”. Beton, Volume 42, No.6, page 318-323, Düsseldorf (1992). (With S. Desenritter).

“DER SCHÜRZBERGTUNNEL OBERRIEDEN”. A3 Bau - Das Österreichische Baumagazin, Volume 19, No.1-2/1992, page 102-103, Gießhübl (1992).

“OBERRIEDEN ROAD TUNNEL, VARIATIONS ON A NATM THEME”. Tunnels & Tunnelling, Volume 23, No.11, page 49-51, London (1991). (With J. H. Deinhard & H. Prinz).

## Lectures

*“Modern Norwegian Tunnelling”*, Workshop organized by the Tunnelling association of India (TAI), 28<sup>th</sup> August 2021(on line)

*“Modern urban tunnelling – Responding to social needs”*, 68<sup>th</sup> Geomechanics Colloquium Salzburg, Austria 10<sup>th</sup> & 11<sup>th</sup> October 2019 (with Wojtech Gall)

*NATM (SEM) From Design to Construction – A Few Considerations about NATM* [Presentation], Vietnam's Hanoi, Ho Chi Minh City (HCMC) & Danang Metro Rail Project Conference 2019

*Lessons Learned in NATM Tunnelling*, TUCSS Tunnelling Seminar 2018, Singapore, 2018

*Tunnel Repair – Lessons Learned*, SEACETUS 2017, April 17/18, 2017

*Special Measures for a Special Project – Victoria Station Upgrade, London, UK.* [Presentation] International Symposium on Advances in Ground Technology and Geo-Information (IS-AGTG), Singapore, 1-2 December 2011. (K. Zeidler, I. Heath & A. Bedi)

*Challenges in SCL Tunnelling.* [Presentation] British Tunnelling Society – Young Members, London, 3 November 2010.

*Modern NATM Techniques in Urban Tunnelling.* [Presentation] Geotechnical Seminar, Geotechnical Society of Singapore, Singapore, 28 July 2010.

*Advanced NATM Construction Methods – Worldwide Applications.* [Presentation] Thailand Underground and Tunnelling Group (TUTG), Bangkok, 25 March 2010.

*Modern Applications of SCL (NATM).* [Presentation] British Tunnelling Society Course on Tunnel Design and Construction, London, June 2008.

*Meeting the Client's Criteria.* [Presentation] British Tunnelling Society Course on Tunnel Design and Construction, London, June 2007.

*Modern Applications of SCL (NATM).* [Presentation] British Tunnelling Society Course on Tunnel Design and Construction, London, 25-29 June 2007.

*Utilization of Lattice Girders in Underground Shotcrete Support – Practical Aspects, Engineering Assessment of Lattice Girder Options.* [Presentation] American Commercial, Inc., Bristol, Virginia, 01 October 2002.

*Sprayed Concrete Lining Design.* [Presentation] Course on tunnel design and construction by the British Tunnelling Society, London, 25-27 June 2002.

*Temporary Rock Support – Rock Bolts.* [Presentation] "Rock Support in Medium to Poor Rock Conditions", course by International Centre for Geotechnics and Underground Construction (CUC), Switzerland, 8-10 May 2001.

*The Need for Waterproofing; Types of Waterproofing Systems (Overview).* [Presentations] Waterproofing of Tunnels, International Centre for Geotechnics and Underground Construction, Switzerland, 29 January – 1 February 2001.

*Sprayed Concrete Lining Design – Design of SC and SC insitu Linings* [Presentation] British Tunnelling Society Course on Soft Ground Tunnelling, London, 9-11 June 1998.

*Sprayed Concrete.* [Presentation] British Cement Association Course on Tunnels and Tunnelling, London, 1 December 1997.

*Shotcrete in Tunnelling.* [Presentation] British Cement Association Course on Tunnels and Tunnelling, London, 1 December 1996.

*Geological and Geotechnical Investigation for Tunnels; Tunnel Excavation Methods; Tunneling Options for Various Ground Conditions; Shotcrete Linings; Monitoring* [Presentations] Tunneling Seminar, Santiago De Chile, November, 1996.

*Sprayed Concrete.* [Presentation] British Tunnelling Society Course on Hard Rock Tunnelling, London, 10-12 September 1996.