TUNNELLING
IS OUR
BUSINESS

Company Profile

Underground Construction & Tunnelling

Tunnel Baumleite, Schalkau, Germany

Foto: Wolfgang Sitter

Contact

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E-mail	spezialtiefbau@bemo.net


Diaphragm Walls
Ground Engineering Dept., Metro Karlsruhe, Germany

Branch Office Sweden, Stockholm (SWEDEN)

Beton- und Monierbau Tunnelling GmbH, Österrike, Sverige Filial

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Branch Office Norway, Oslo (NORWAY)

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2275 Lake Shore W. Suite 530, Toronto, Ontario M8V 3Y3, CANADA

E-mail	canada@bemo.net

Subsidiary Beton- und Monierbau USA, Inc. (USA)

Beton- und Monierbau USA, Inc.

20 NW Fourth Street, 7th Floor, Evansville, IN 47708, USA

E-mail	office-usa@bemo.net

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Executive Summary

BeMo Tunnelling GmbH (abbr. BeMo), with headquarter in Innsbruck, is a specialist in the design and construction of all kinds of underground structures, whether new construction, refurbishment, reinstatement or reconstruction.

Our experienced staff and know-how make us a world leader in our field, as can be seen from our excellent project record. A total of 400 kilometres of tunnels and underground structures of different sizes and dimensions have been built by BeMo over the past 50 years. Our annual turnover in tunnelling is approx. 150 Mio EUR.

Our highly qualified and committed team of experts (Project Managers, Project Engineers, Supervisors, Superintendents and Specialists) is known internationally for its broad scope of technical competence and innovative solutions for the design and delivery of complex and challenging tunnel works. It is our goal to maintain and strengthen our excellent global reputation.

BeMo Tunnelling creates value for everyday life by implementing complex infrastructure projects that contribute to the well-being of society in a safe, efficient and sustainable manner. Thanks to our professionalism together with the high quality of our services we are a preferred contractor for partners and clients alike.

We are fully committed to protecting the well-being, health and safety of our staff. We therefore work hand in hand with occupational health and safety organisations to continuously improve our structures, systems and efforts.

Current tunnelling activity is amongst other underground schemes in prestigious and challenging projects for public clients. In the following summary of tunnel-projects under construction BeMo plays a leading role either as Main Contractor or Joint-Venture Partner:

Strengener Tunnel, Strengen, Austria

Achrain Tunnel, Dornbirn, Austria

Exploratory gallery HEPP-Tauernmoos, Uttendorf, Austria

- Reinstatement Tunnel Arlberg, Austria, ASFINAG
- Metro “Stadtbahntunnel” Karlsruhe, Germany, KASIG
- Stuttgart 21, Lot 3 Bad Cannstatt, Germany, DB Netz AG
- Tunnel Klaus South, section 5, Austria, ASFINAG
- Tunnel Zierenberg, Germany, DB Netz AG
- Power Plant „Gemeinschaftskraftwerk Inn“ Prutz/Ried, Austria, GKI
- Reinstatement Old Bebenroth-Tunnel, Germany, DB Netz AG
- Mining „Schacht Konrad“, Germany, DBE
- C510 Whitechapel and Liverpool Station Tunnels, Great Britain, Crossrail Ltd.

Executive Summary (cont'd)

Since 1964 the company's activities have been undergoing constant expansion. BeMo with its innovative tender proposals for difficult construction lots and its technological innovations was always at the forefront of the development of the New Austrian Tunnelling Method (NATM).

The great experience thus acquired led the company to set up a Division for Know-how Transfer, which exports the know-how of BeMo´s engineers to many countries throughout the world.

In recognition of its merits for the advancement, promotion and further development of NATM, BeMo was granted the right to bear the Austrian state coat of arms in 1982.

To ensure that our products and services continue to remain on the technological leading edge and meet the requirements of an ever-changing global business environment, BeMo Tunnelling strives to provide our customers with state-of-the-art engineering solutions through continuous improvement and further development.

Environmental impacts, such as noise, dust and the consumption of resources, are unavoidable in the execution of our projects. BeMo Tunnelling is fully aware of its considerable responsibility to protect the environment while avoiding damage to property and conscientiously using resources. We endeavour to act in an environmentally accountable manner on every project.

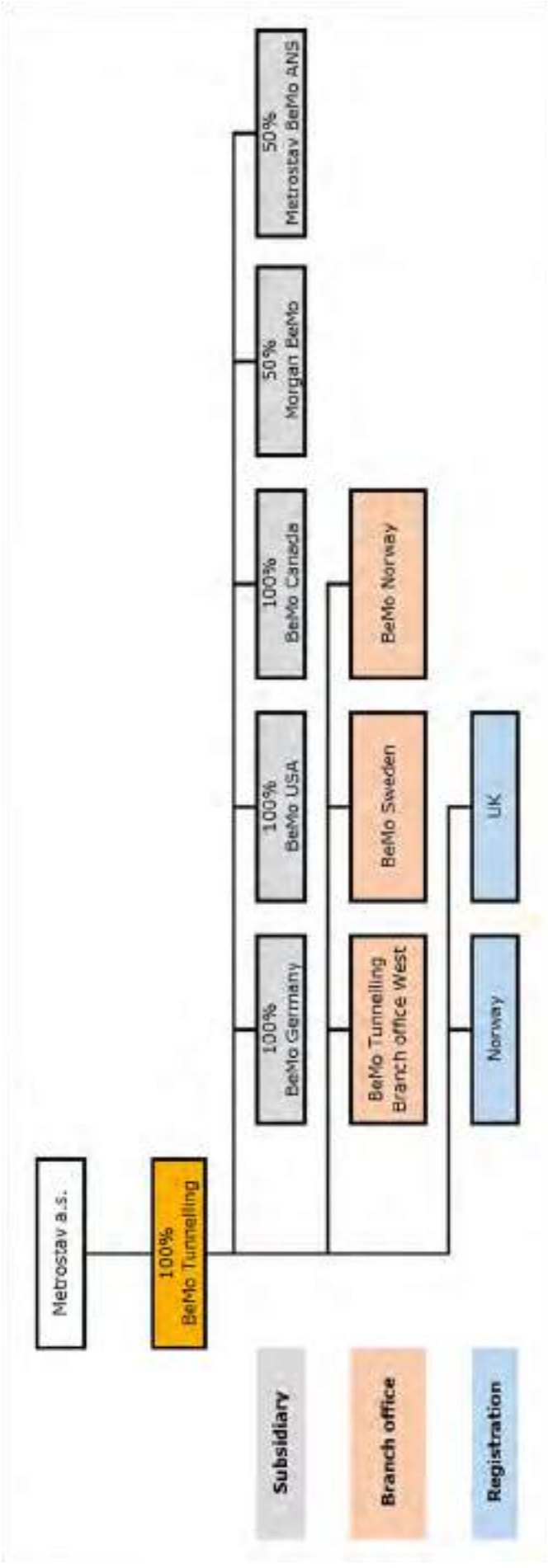
BeMo was one of the first companies within the tunnelling industry of Germany and Austria to introduce and certify a Quality Management System (QMS) according to the ISO 9000 series in the year 1995, followed by certifications of OHSAS 18001 and SCC** in the year 2004 and ISO 14001 in 2007.

Meanwhile we have introduced an Integrated Management System (IMS), which we are continuously improving and developing. Our IMS consists of an Occupational Health and Safety Management System according to OHSAS 18001 and SCC**, a Quality Management System according to ISO 9001 as well as an Environmental Management System according to ISO 14001.

Kings Cross Station Redevelopment, London, UK

Powerhouse Cavern Kopswerk II, Partenen, Austria

Group Structure
Metrostav a.s. / BeMo Tunnelling



Company Profile

Name:	BeMo Tunnelling GmbH (Abbreviation: BeMo)
Companies Register (Court):	FN 46175f (“Landesgericht Innsbruck”)
Legal form:	limited liability company (“Gesellschaft mit beschränkter Haftung”)

Managing Directors:

Dipl.-Ing. Friedrich Neureiter

Dipl.-Ing Helmut Göhringer.

Dipl.-Ing. Peter Henkel

Year founded: 1964

Activities / Areas of expertise

BeMo Tunnelling is a specialist in the engineering and construction of all kinds of underground structures, whether new construction, refurbishment, reinstatement or reconstruction.

- Underground Construction & Tunnelling
  - Tunnels for major transportation projects including road, light-rail, metro, rail and underground stations
  - Shafts & Special Structures
  - Mining
- Special Foundation Engineering
- Power Plant Construction & Tunnelling
  - Tunnels and facilities for water and energy sector
    - Caverns
    - Water tunnels
    - Sewage tunnels
- Know-how Transfer & Consulting
- Design for Tunnels and Underground Structures
- Tunnel Survey & Geotechnical Measurements for Tunnelling
- Tunnel Refurbishment, Reinstatement and Reconstruction
- Maintenance/Refurbishment of Buildings & Structures

State-of-the-art technology for all types of ground

Our experienced staff and know-how make us a world leader in our field, as can be seen from our excellent project record. Our highly qualified and committed team of experts is known internationally for its broad scope of technical competence and innovative solutions for the design and delivery of complex and challenging tunnel works.

- New Austrian Tunnelling Method (NATM)
- Sprayed Concrete Lining (SCL)
- Sequential Excavation Method (SEM)
- Shotcrete Tunnelling
- Scandinavian Method
- TBM-Tunnelling (EPB-/Slurry-/Hydro-/Mix-/Single-/Double-Shield, Gripper, Partial-face)

Certifications:

Safety Management System certified according to the standards of OHSAS 18001 and SCC**

Environmental Management System certified according to the standard of ISO 14001

Quality Management System certified according to the standard of ISO 9001

qualityaustria
SYSTEM CERTIFIED
ISO 9001 NR.00574/0
ISO 14001 NR.00716/0
SCC** NR.00102/0
OHSAS 18001 NR.00026/0

Company Profile (cont'd)

Awards:

In recognition of its merits for the advancement, promotion and further development of the New Austrian Tunnelling Method (NATM), BeMo was granted the right to bear the Austrian state coat of arms in 1982

Tunnelling Industry Awards 2002
Major Project Award
North Downs Tunnel, Rochester, England, UK

Tunnelling Industry Awards 2004
Achievement Through Innovation
Development of LaserShell™ and TunnelBeamer™

American Shotcrete Association Award 2006
Outstanding Shotcrete Underground Project Award
Weehawken Tunnel and Bergenline Avenue Station Project, Weehawken, New Jersey, USA

Trademarks:

CombiShell™
COMBISHELL™

LASERSHELL™

TunnelBeamer™
TUNNELBEAMER™

UltraShell™
ULTRA-SHELL™
Ultra-Shell™

Membership of trade and professional associations:

Member of the Association of Industrial Construction Companies Austria ("Vereinigung industrieller Bauunternehmungen Österreichs", VIBÖ)

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

Member of the Austrian Society for Concrete- and Construction Technology ("Österreichische Bautechnik Vereinigung")

Member of the Austrian Research Community Road Railway and Transit („Österreichische Forschungsgesellschaft Straße Schiene Verkehr", FSV)

Corporate Affiliate Member of the International Tunnel Association (ITA-AITES)

Member of the Swedish Construction Federation ("Sveriges Byggindustrier")

Member of the Swedish BK Bergsprängningskommittén

Background & History

BeMo Tunnelling is an internationally operating Austrian tunnelling company.

Beton- und Monierbau Gesellschaft m.b.H. (BeMo) was founded in October 1964, based on a philosophy of steady technical development, and engaged right from the beginning in the construction of tunnels. BeMo has always been a leading influence in introducing the New Austrian Tunnelling Method (NATM) to the international market. We have continuously developed the method with our special tender proposals for challenging projects. Since 1969 its activities were expanded to the neighbouring countries.

In co-operation with Prof. L. Mueller, a founder of the New Austrian Tunnelling Method (NATM), Beton- und Monierbau used NATM for metro construction in Frankfurt, Germany (special proposal by BeMo). This was the first time that NATM was applied successfully for an inner-city metro: Metro Frankfurt, Contract Section 25 – inner-city metro lot comprising of tunnels 4-7 m beneath the foundations of six buildings including the historic building "Frankfurt Roemer".

In recognition of its merits for the advancement, promotion and further development of NATM, BeMo was granted the right to bear the Austrian state coat of arms in 1982. In the meantime BeMo has proved that there are almost no geological or structural conditions to which the NATM cannot be effectively applied.

Since 1977 projects in the field of continuous excavation (TBM) were carried out. Besides metro construction projects BeMo was also the leading partner in numerous road- and railway-tunnel projects in Austria and Germany. The great experience acquired, the outstanding reputation in the field of tunnelling and the own divisions for structural engineering and tunnel design, mechanical engineering and tunnel survey & geotechnical measurement were the reasons for BeMo to establish the Division for Know-how Transfer in 1990.

Apart from the main countries Austria and Germany successful tunnel construction projects were carried out in England, Sweden, Spain and the USA. Several international recognised awards could be achieved with these projects.

Since the ending of 2013 BeMo has been part of the METROSTAV Group as an independent subsidiary.

Egge Tunnel, Willebadessen, Germany

Blisadona Tunnel, Arlberg, Austria

Hemberg Tunnel, Uentrop-Wennemen, Germany

Kings Cross Station Redevelopment, London, UK

Background & History (cont'd)

Since 31 December 1990, Metrostav a.s. has been the legal successor to the state-owned company of the same name (established in 1971). During its history, Metrostav a.s. has changed from a specialised firm, focusing on the construction of the Prague Metro, into a universal construction company whose name is automatically associated with reliability, quality and stability.

Metrostav a.s. is an esteemed partner and respected competitor in the area of reconstruction of national heritage monuments and in both industrial and housing construction. Its activities are spread over all construction areas and cover almost half the underground engineering market: as one of the few Czech companies it provides highly specialised underground works performed by mining methods. For the third millennium, Metrostav a.s. pursues a programme of sustaining and improving a high quality level in the key structural technologies such as reinforced concrete structures, insulation systems and various methods of driving underground works under the most challenging projects our clients may have.

Since 1998, Metrostav a.s. has been a holder of the internationally recognised ISO 9001 quality management certificate in respect of general contracting for construction engineering projects, awarded by BVQI in London. It can tender for large projects for the Army and implement plans in other security areas in both the Czech Republic and NATO member countries, because it was awarded the Certificate of the National Security Office. Revenues in 2012 amounted to 800 million EUR and the group had more than 3.400 employees.

BeMo's and Metrostav's activities cover all areas of building and they are a reference in undertaking civil engineering (underground construction, tunnelling, roads, railways, airports, water works, marine work) and building (residential and non-residential) both nationally and internationally.

Financially well backed and technically perfectly equipped, BeMo undertakes even extremely difficult and huge projects. Going back to 1964 our portfolio contains many milestone projects. Few companies can claim such accumulated experience in the field of underground construction. Whilst we take pride in achievements of the past, our philosophy is one of innovation, development, partnering and long lasting relations with our clients.

Corporate Logo, Metrostav a.s., Czech Republic

Metro TBM, Razeny, Czech Republic

Tunnellbuilding, Petriny, Czech Republic

Bridgebuilding, Trojsky, Czech Republic

Major Project Award 2002

Winner: Eurolink JV – Morgan Tunnelling, Vinci, BeMo

Project: North Downs Tunnel, Channel Tunnel Rail Link (CTRL), Contract Section CTRL 410, Rail Link Engineering

The 3.2-km-long 116 Mio EUR North Downs Tunnel in Kent, UK forms part of Section 1 of the Channel Tunnel Rail Link. The tunnel, constructed beneath Bluebell Hill with up to 100 m of cover through upper, middle and lower chalk, is a 13 m wide, 10 m high single bore and was tendered and let under the spirit of partnering.

A value engineering workshop was undertaken at the design stage where the project manager / contractor identified substantial realistic savings. With an unprecedented safety record the project was completed 6 months ahead of schedule.

Judging Panel's Comments: The award goes to a project managed through the ECC/C Contract combined with the partnering approach. It was successfully completed 6 months early, yielded several millions of pounds as a saving shared by all parties, and must be seen by many as a model way of carrying out the contracting business. In view of this contract's critical position in the overall project's completion it was absolutely necessary for all parties of the partnering process to jointly carry out value engineering on-site resulting in a reduction of a primary shotcrete lining thickness, the removal of reinforcement from the secondary lining and a general slimming down of the tunnel invert.

The judges believe that this demonstration of teamwork through genuine partnering has been the main factor leading to the major success of this contract and the Committee applauds the result.

Article adapted from: Tunnels & Tunnelling International, June 2002

North Downs Tunnel, Rochester, UK

North Downs Tunnel, Rochester, UK

Tunnelling Industry Award 2004

BeMo Tunnelling and their UK partner Morgan Sindall (Infrastructure) (formerly: Morgan=Est) were awarded the Tunnelling Industry Award 2004 as winners in the category for **"Achievement Through Innovation"**.

The **TunnelBeamer™** system had been developed around **LaserShell™**, a construction method introduced by BeMo Tunnelling and their UK partner Morgan Sindall.

The method employs an inclined face excavation for increased stability and improved safety, and provides robust face and vault support measures, while allowing access to clean and prepare the invert prior to the construction of structural lining.

LaserShell™ and **TunnelBeamer™** are registered Trademarks of BeMo Tunnelling and Morgan Sindall.

TunnelBeamer™, North Downs Tunnel, Rochester, UK

LaserShell™, Heathrow Terminal 5, London, UK

Outstanding Shotcrete Project Award 2006

In January 2007, the Frontier Kemper, J.F. Shea, BeMo Tunnelling Joint Venture was awarded the American Shotcrete Association's Outstanding Shotcrete Underground Project of the Year Award 2006 at the American Shotcrete Association's (ASA) Membership Meeting and Annual Banquet for the Weehawken Tunnel and Bergenline Avenue Station Project, Weehawken, New Jersey, USA.

2006 Project of the Year, Underground Shotcrete, ASA

Weehawken Tunnel and Bergenline Avenue Station, Weehawken, New Jersey, USA

Weehawken Tunnel and Bergenline Avenue Station, Weehawken, New Jersey, USA

BCIA Award 2015 & NCE Tunnelling Award 2015

BeMo Tunnelling and their partners Balfour Beatty (UK), Morgan Sindall (UK) and VINCI (France) where awarded with the BCIA Product Design Innovation Award (Civil Engineering) in October 2015 and with two NCE Tunnelling & Underground Space Awards in December 2015 - "Product / Equipment Innovation of the Year" and "Technical Innovation of the Year" - for their innovative “Uphill Excavator” used at their construction site Crossrail, Contract C510 in London.

British Construction Industry Award 2015

Judges’ comment: “This innovation will have a lasting change on industry practice. It has not focused solely on commercial gain.”

Contractor BBMV JV C510 decided to use an “uphill excavator” to dig out 30° inclined escalator shafts for Crossrails’s Liverpool Street and Whitechapel stations. Conventionally, these shafts are excavated from the top down, as this is safer. On contract C510 it was decided to excavate from the bottom up because of the need to maintain and efficient working schedule with other contractors working on adjacent shafts.

The Uphill Excavator comprises both an excavating and shotcrete spraying arm complete with operator’s cab which is suspended from the crown of the constructed tunnel and advances in line with tunnel progression. A bespoke walkway running alongside the excavator provides the engineer with a save location from which to carry out work, while still ensuring they can be in visual and audible communication with the driver. The walkway also provides emergency egress for the operator at any point during the tunnelling operation.

The Uphill Excavator enabled BBMV to construct key connections much earlier than would have been possible with traditional downhill methods and also significantly improved safety for operators.

The key to success of Uphill Excavator is the suspension rail system that is installed as it advances, and the machine itself which can act as an excavator, spraying arm and working platform.

Uphill Excavator

The **British Construction Industry Awards** (BCI Awards or BCIA) were launched by the New Civil Engineer magazine and Thomas Telford Ltd - both owned by the Institution of Civil Engineers - in 1998.

The awards seek to recognise outstanding achievement in the construction of buildings, taking account of a wide range of factors including architectural and engineering design, but also consideration of the construction process, delivery to time and budget, and client satisfaction.

The **NCE Tunnelling & Underground Space Awards** were launched by the New Civil Engineer magazine in 2010.

Judges from over 30 industry leaders including key clients, contractors and consulting engineers recognise outstanding achievement in the construction of underground structures and tunnels.

NCE Tunnelling & Underground Space Awards 2015 "Product/Equipment Innovation of the Year" and "Technical Innovation of the Year"

Underground Construction & Tunnelling

BeMo Tunnelling is a specialist in the engineering and construction of all kinds of underground structures, whether new construction, refurbishment, reinstatement or reconstruction.

Over the past 20 years a total of 400 kilometres of tunnels and underground structures of different sizes and dimensions have been built by BeMo.

The span of operation in Underground Construction & Tunnelling includes:

- Tunnel Construction, Reconstruction and Modernisation
  - Tunnels for major transportation projects including road, light-rail, metro, rail and underground station contracts
  - Tunnels and facilities for the water and energy sector
  - Hydroelectric Power Plants & Dams
  - Underground Power Plants
  - Caverns, Galleries and Tunnels
  - Water Tunnels & Sewage Tunnels
  - Shafts & Special Underground Structures
  - Mining
- Know-how Transfer & Consulting
- Design for Tunnels and Underground Structures
- Tunnel Survey & Geotechnical Measurements for Tunnelling
- Tunnel Refurbishment, Reinstatement and Reconstruction
- Maintenance/Refurbishment of Buildings & Structures
- Slope-Protection

Our highly qualified and committed team of experts is known internationally for its broad scope of technical competence and innovative solutions for the design and delivery of complex and challenging tunnel works including:

- New Austrian Tunnelling Method (NATM)
- Sprayed Concrete Lining (SCL)
- Sequential Excavation Method (SEM)
- Shotcrete Tunnelling
- TBM-Tunnelling
  - EPB-/Slurry-/Hydro-/Mix-Shield
  - Single-/Double-Shield, Gripper
  - Partial-face (roadheader)
- Scandinavian Method
- Rock-Tunnelling
- Tunnelling in soil and soft ground

Powerhouse Cavern Kopswerk II, Partenen, Austria

Metro Bochum Lot 306, Bochum, Germany

UWWTD Flow Transfer Works, T3 Tunnel Recovery Program, Hull, UK

Tunnel-Design

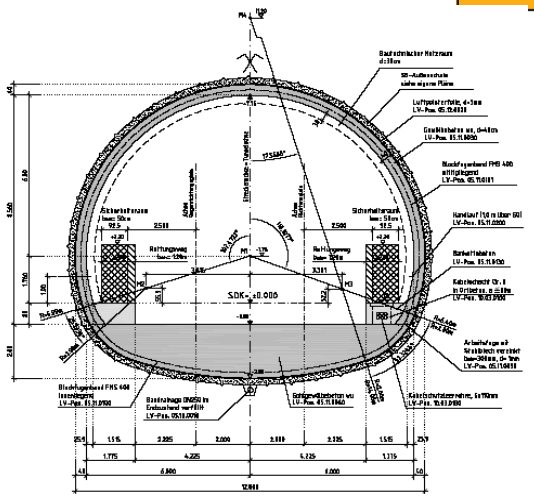
BeMo´s design know-how is based on more than 40 years of experience.

Key services provided by **Tunnel-Design** are as follows:

Detailed Design

Continuous feed-back from our tunnel-construction sites and being seamlessly involved in the projects enables optimisation of our designs with respect to

- **Safety**
- **Quality**
- **Constructability**
- **Programme**
- **Cost saving**



Detailed Design – Cross Section, New Ramholz-Tunnel, Sinntal-Sannerz, Germany

Detailed Design – Long Section, Metro Bochum Lot 306, Bochum, Germany

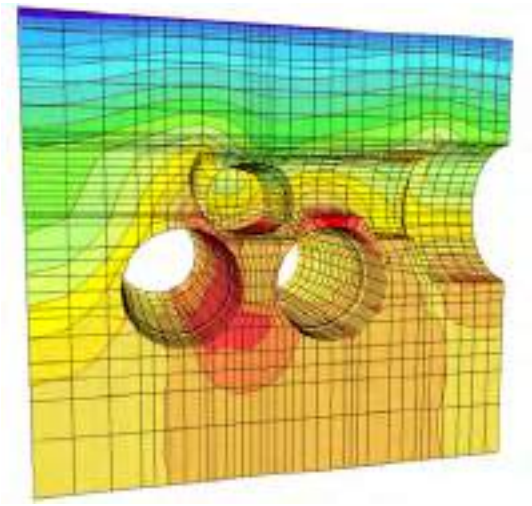
Cross Section – Client's design proposal, Metro Bochum Lot 306, Bochum, Germany

Value Engineering Proposals
and
Feasibility Studies

Together with the site teams Value Engineering Proposals are developed leading to higher quality, safety, innovation and overall cost reduction for our clients.

Cross Section – Value Engineering Proposal, Metro Bochum Lot 306, Bochum, Germany

Tunnel-Design (cont'd)

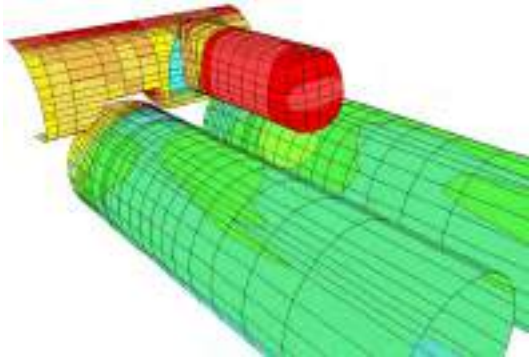


Numerical Modelling – 3D-FE-Model, Shepherd's Bush Station, London, UK

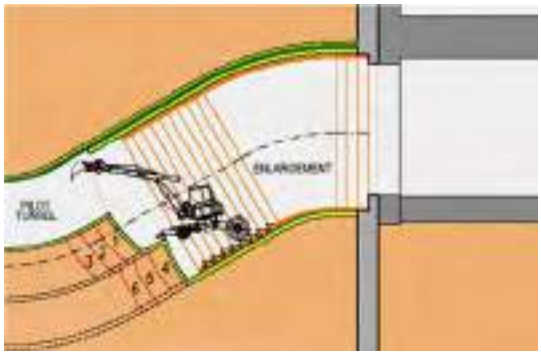
Numerical Modelling

Having more than 30 years of experience in this field **Tunnel-Design** has got the expertise for carrying out complex 2D and 3D analyses using state-of-the-art program packages for design purpose and feasibility studies enabling modelling of

- **Construction process**
- **Nonlinear material behaviour for soil, rock, concrete, steel, etc.**
- **Steady state and transient seepage flow**
- **Consolidation**
- **Steady state and transient heat transfer**
- **Dynamics**



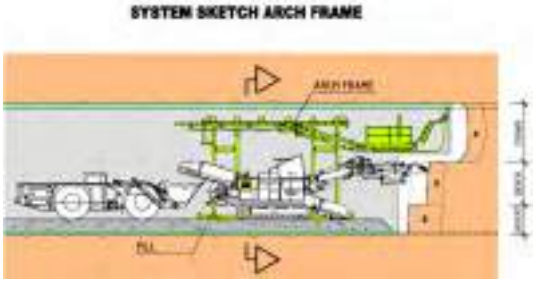
Numerical Modelling – Shell Model, Shepherd's Bush Station, London, UK



Construction Sequence Escalator Barrel, Kings Cross Station Redevelopment, London, UK

Method Selection
and
Construction Sequencing

In close cooperation with the site team and the Mechanical Engineering & Plant Department, construction methods and construction sequences are selected.



Construction Sequence, Metro Bochum Lot 306, Bochum, Germany

Division Know-how

Existing Know-how at BeMo Tunnelling

One of the **core competences** of our company is the **implementation** of tunnel projects using the New Austrian Tunnelling Method (NATM), also known as Sprayed Concrete Lining (SCL), Sequential Excavation Method (SEM) or Shotcrete Method.

This method allows the economic production of large underground cavities using shotcrete combined with rock anchoring as the means for securing the structure.

Experience in the use of shotcrete is therefore also to be regarded as one of our core competences. Tunnelling and in particular NATM are characterised by the need for **experienced and specialized personnel** on site, with miners (skilled labourers at the tunnelling work face) at the base and project engineers / managers for site management.

The experience of the miners is essential for the successful and economical execution of a NATM project. The broad know-how of the on site personnel is a major factor for the success of our enterprise.

In addition to these core competences, BeMo operates the following Divisions and Departments at the company headquarter:

- **Tunnel-Design & Structural Engineering**
- **Estimation & Work Preparation**
- **Technical Controlling**
- **Quality Management**
- **Mechanical Engineering & Plant Department**
- **Department for Survey & Geotechnical Measurement**
- **Department for Maintenance of Buildings & Structures**

The **Tunnel-Design-Department** is above all responsible for value engineering, special proposals, preparation of quotations for major projects and for the detailed design for the implementation of tunnelling projects.

Tunnelbeamer™ and LaserShell™, Heathrow Terminal 5, London, UK

CombiShell™, Heathrow Baggage Tunnel, London, UK

NATM in frozen ground, UWWTD Flow Transfer Works, T3 Tunnel Recovery Program, Hull, UK

Metro Almaty, Almaty, Kazakhstan

Division Know-how (cont'd)

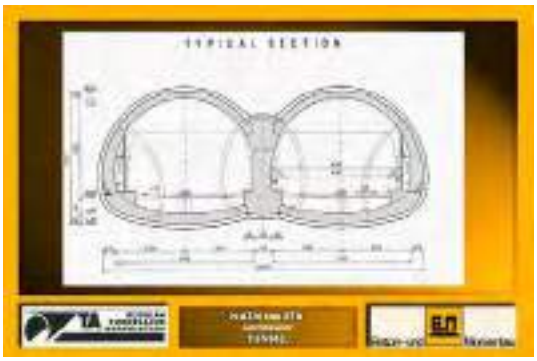
Our Know-how

Know-how for tunnelling and underground construction projects:

- **Feasibility Studies**
- **Design Know-how**
- **Project Planning**
- **Project Development**
- **Estimation and Tender Preparation**
- **Value Engineering Proposals**
- **Method Selection and Construction Sequencing**
- **Operation and Maintenance**
- **Finance**

Know-how about required resources for the construction of an Underground Structure and Know-How to complete structures safe, in time, within budget, and according to high quality standards:

- **Personnel**
- **Plant & Equipment**
- **Energy** and **Materials**



UFA – Know-how Transfer, Ufa, Russia

UFA – Know-how Transfer, Ufa, Russia

TunnelBeamer™ Training, Heathrow Terminal 5, London, UK

Division Know-how (cont'd)

Available Know-how from BeMo Tunnelling

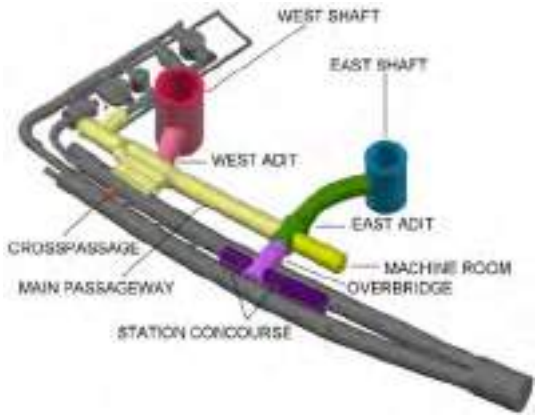
Construction Know-how for your tunnel project

- We provide know-how and specialist-resources to international contractors
- Co-operation between international contractors to combine strength for a tunnel project
- Advantage for partners: use local (cost-saving) resources and get access to resources such as know-how, design experience, specialized personnel (blue and white collar) and tunnelling equipment.
- Advantage for cost-structure of project
- Tailored offer for partners can be proposed (right mix of local resources and specialist-resources is key to success)

Please find a catalogue of BeMo's Know-how services on our website http://www.bemo.net

LaserShell™, Heathrow Terminal 5, London, UK

LaserShell™ with SGI-Lining, Kings Cross Station Redevelopment, London, UK



3D-Model, Shepherd's Bush Station, London, UK

Division Know-how (cont'd)

Know-how Transfer projects

Project	Year	Type of Technology Transfer	Client / Partner	Project-Implementation
CombiShell™ Heathrow Airport Baggage Tunnel	94-96	Detailed Design and assistance for the execution for a new tunnelling Method (Design, provide specialists, provide specialist equipment)	Miller Tunnelling, UK (now: Morgan Sindall (Infrastructure))	London, England, UK
Korean High Speed Railway and Seoul New Airport Highway	95-96	Provide specialists for tunnel supervision and special tunnel trades	Hyodong, South Korea	Taejon, Seoul, South Korea
Lower Kihansi Project	95-96	Project-execution study and supervision on site	Impregilo S.p.A., Italy	Iringa, Tanzania
Ufa Motorway Tunnel Detailed Design	96-96	Detailed Design and Know-how Transfer for UFA Motorway Tunnel	TA Moscow, Russia	Ufa, Bashkortostan, Russia
Ufa Motorway Tunnel Feasibility-Study	96-96	Feasibility Study for UFA Motorway Tunnel	TA Moscow, Russia	Ufa, Bashkortostan, Russia
North Hollywood Extension, Metro's Red Line	05-07	Detailed Alternative Design and Structural Analysis, Value Engineering (VECP)	Traylor Bros. Inc. / Frontier Kemper, USA	Los Angeles, California, USA
Heathrow Airport Terminal 5 LaserShell™ TunnelBeamer™	01-02	NATM-Alternatives for Tunnelling and Underground-Structure at Airport Heathrow Terminal 5. Development of LaserShell™ and TunnelBeamer™	Morgan=Est, UK (now: Morgan Sindall (Infra.), Vinci, France	London, England, UK
Metro Puente Alto	03-04	Design, Technical Support, Provide specialists for NATM, preparation of special technical proposals	Consorcio V.E.I., Chile	Santiago, Chile
Metro Almaty, Zhibek Zholy Station	04-06	Design, Technical Support, Training and Provision of specialists and equipment for NATM	OAO Almatymetrokurylis, Kazakhstan	Almaty, Kazakhstan
Metro Los Angeles Gold Line Eastside Light Rail Transitway Extension	05-07	Design-input for NATM-Crosspassages between TBM-Metro-Tunnels, Consulting and Technical support, Provision of specialists for NATM for Eastside Extension Crosspassages in soft, pretreated ground below groundwater-level	Traylor Bros. Inc. / Frontier Kemper, USA	Los Angeles, California, USA
Beacon Hill Station Project, C170, Central Link Light Rail	05-08	Consulting, Provision of specialists for SEM/NATM in soft ground for Beacon Hill Station	Obayashi Corp., USA	Seattle, Washington, USA
San Vicente Pipeline, Emergency Storage Project, Reach 5	06-06	Estimation assistance, design-input for Reach 5, Consulting, Provision of specialists for NATM in Reach 5 conglomerate	Traylor Bros. Inc., USA	San Diego, California, USA
Metro Caracas Linea 5, Station Bello Campo	08-08	Feasibility-Design, Technical Support, Training	Metro de Caracas	Caracas, Venezuela
NATM Tunnel Tysons Corner	09-11	Consulting, Technical Support, Training and Provision of specialists for SEM/NATM in soft ground	Dulles Transit Partners	Vienna, Virginia, USA

Division Know-how (cont'd)

Know-how Transfer projects

Project	Year	Type of Technology Transfer	Client / Partner	Project-Implementation
New York East Side Access, Queens Bored Tunnels	10-12	Essential design-input for 3-cell NATM crosspassage between Yard Lead Tunnel and Emergency shaft structure; Consulting and Technical Support during execution; Know-how transfer; two SEM/ NATM Tunnel Superintendents for round the clock coverage on site	Granite – Traylor – Frontier JV	Long Island City, Queens NY, USA
Seattle University Link Light Rail – Contract U220	11-12	Consultant for execution of SEM/NATM crosspassages between two segmentally lined TBM tubes; Technical Support, Know-how transfer; Senior NATM Tunnel Engineer on site	Traylor Frontier JV	Seattle, Washington, USA
Chinatown Station, San Francisco	12	Estimating assistance	US Contractor	San Francisco, USA
Regional Connector Los Angeles	13	Estimating assistance	US Contractor	Los Angeles, USA
First Street Tunnel Project – Washington, D.C. Clean Rivers Project Division P	13-14	Design-review for NATM-Adits in soft ground, consulting and technical support	Parsons Brinkerhoff (Lead Designer) in association with Skanska – JayDee JV	Washington, D.C., USA
Plymouth Tunnel	14	Estimating assistance, design input	US Contractor	Silver Springs, MD, USA
Green Valley Tunnel Edmonton	15	Estimating assistance, design input	US Contractor	Edmonton, AB, Canada
Seattle East Link	15	Estimating assistance, design input	US Contractor	Seattle, WA, USA
Guayasamin Tunnel	15	Expertise on fracturing of inner lining	Pontificia Universidad Catolica	Quito, Ecuador
Regional Connector Los Angeles	15	Design review SEM cross over cavern	Skanska – Traylor jv	Los Angeles, CA, USA
Chinatown Station, Central Subway, San Francisco	15	Consulting, technical support, training and provision of specialists for SEM / NATM works in soft ground (pipe umbrellas, shotcrete, divided cross sections, …) and urban surrounding	Frontier Kemper	San Francisco, CA, USA
John Hart Generating Replacement Project, Vancouver Island	15	Consulting, technical support, training and provision of specialists for SEM / NATM works in soft ground (pipe umbrellas, shotcrete, …)	Frontier Kemper	Campbell River, BC, Canada

Success Story CombiShell™

Scope

British Airways Heathrow Airport Ltd. was the client for the Heathrow Baggage Tunnel Transfer Tunnel works between Terminal 1 and Terminal 4. The running tunnels were constructed using the shield method, lined with steel fibre reinforced concrete segments. At each end of the main running tunnel enlargements up to a diameter of 9.4 m were required, with cross passages to the shafts.

CombiShell™, Heathrow Baggage Tunnel, London, UK

CombiShell™ Method of Tunnelling

With the great flexibility offered by NATM, chamber geometries were developed which neatly enveloped the complex path of the baggage handling system whilst minimising overall excavation volumes. Located directly below operational aircraft stands, settlement considerations and safety of construction were of paramount importance. The novel tunnelling system utilised sprayed concrete for both the primary and secondary linings acting as a permanent composite structure. The design of the **CombiShell™** proposal was undertaken by Morgan Sindall (Infrastructure) (formerly: Morgan=Est; formerly: Miller Tunnelling), England and BeMo Tunnelling under a “technology transfer” agreement. BeMo utilised computer modelling techniques together with its more than 30 years of experience in order to achieve economical and practical schemes.

CombiShell™, Heathrow Baggage Tunnel, London, UK

The construction of the junction demonstrated the flexibility of **CombiShell™** techniques and allowed a cost saving of some 30 % over traditional British methods requiring massive temporary supports. **CombiShell™** saves money - if and only if the contractor employs qualified personnel, because supervision and workmanship at the face is of the utmost importance.

CombiShell™, Heathrow Baggage Tunnel, London, UK

CombiShell™ is a registered Trademark of BeMo Tunnelling and Morgan Sindall (Infrastructure).

CombiShell™, Heathrow Baggage Tunnel, London, UK

Registered Trademarks


TRADE MARKS REGISTRY

REGISTRATION CERTIFICATE

CombShell

COMBISHELL

CombiShell™, COMBISHELL™


CERTIFICATE OF REGISTRATION

CERTIFICAT D'ENREGISTREMENT

LASERSHELL

LASERSHELL™


TRADE MARKS REGISTRY

REGISTRATION CERTIFICATE

TUNNELBEAMER

TunnelBeamer

Sealed this day at my direction

TUNNELBEAMER™, TunnelBeamer™


TRADE MARKS REGISTRY

REGISTRATION CERTIFICATE

UltraShell

ULTRA-SHELL

Ultra-Shell

UltraShell™, ULTRA-SHELL™, Ultra-Shell™

Mechanical Engineering & Plant Department

The tasks of the Mechanical Engineering & Plant Department comprise essentially the following areas of operation:

Mechanical engineering / electrical engineering (basic tasks)

- Selection and procurement of mechanical equipment, machines, plant and electrical equipment
- Arrangement and operational planning for machines and plant
- Execution of repairs and maintenance at the plant yards, cost monitoring, repair documentation, expert inspections
- In-house developments of new site-specific equipment, adaption (re-design) of equipment, innovatory improvements on plant and machines

Project-specific tasks / detailed engineering services for company owned projects and the Divisions UK/USA & Know-how

- **Mechanical / electrical estimations / calculations (plant list) for individual projects for consecutive construction stages**
  - Site preparations / excavation / lining / completion works

- **Mechanical / electrical work preparations**
  - Basic logistics considerations (e.g. mucking by conveyor or dump trucks)
  - Equipment operational planning
  - Geometry and kinematic studies of excavation equipment
  - Ventilation calculations, mucking calculations, water pumps calculations
  - Design of complete facilities (e.g. compressed air excavations, compressor systems, locks systems), design of mucking concepts (track / non-track operation)
  - Preparation of cost comparisons of plants, determination of technical specifications and contractual layout of special equipment (e.g. excavation systems, conveyor systems)
  - Detailed investigations of operation requirements of steel formwork, mobile scaffolding, mobile curing gantries with respect to process flow and practice by using developed checklists
  - Design, planning and monitoring of installations of electrical equipment for the site(s) requirements from suppliers mains interchange point to the single consumers

Backup Slurry TBM, Metro Karlsruhe, Germany

Backup Slurry TBM, Metro Karlsruhe, Germany

Equipment for rail tracks dismantling, Arlberg Tunnel – Safety Engineering Upgrade, Langen, Austria

Muck shaft-hoist, Lainzer Tunnel LT 31, Vienna, Austria

Mechanical Engineering & Plant Department

- **Site set-up planning**
  - Detailed shaft planning
  - Lifting gear
  - Ventilation and dedusting equipment
  - Participation in the selection of shotcrete systems

Vault shutter/formwork , Schluechterner Tunnel, Schluechtern, Germany

- **Site services**
  - Arrangements and handling of contracts for investments (plant and equipment)
  - Selection of plant and equipment
  - Check of suitability, performance of regular checks of the equipment concept
  - Adjustment of main equipment concept to main construction progress situations (technical, contractual)
  - Negotiation and contractual preparation for supply of electrical energy
  - Design of emergency electricity supply concepts

Main Ventilation Plant Arlbergtunnel - St. Anton, Austria

Ventilation system side wall drift, Lainzer Tunnel LT 31, Vienna, Austria

Safety related tasks for our company owned facilities and sites

- **Safety-related work preparation**
  - Evaluation of risks and hazards
  - Implementation of measures to achieve high level of safety
  - Design and production of refuge chambers according to project-specific requirements derived from evaluation of likely incident scenarios

Refuge chamber for 20 people and 12hours standalone operation

Mechanical Engineering & Plant Department

- **Safety-related work preparation**
  - Evaluation of risks and hazards
  - Implementation of measures to achieve high level of safety
  - Design and production of refuge chambers according to project-specific requirements derived from evaluation of likely incident scenarios

Emergency training, Strenger Tunnel, Strengen, Austria

Refuge chamber interior

- **Safety site supervision**
  - Organisation and implementation of fire drills / emergency drills
  - Determination of fire-fighting equipment
  - Escape and rescue plans
  - Safety-related inspections of sites, correction of safety defects
  - Evaluation of accident reports, conclusion to accident causes, implementation of measures, accident statistics
  - Detailed investigations of safety-relevant requirements for non-standardised special equipment (e.g. steel tunnel formwork), specification of safety relevant design details, supervision of production and commissioning on site, determination of details as a requirement to production and commissioning of special lining equipment

Firefighting Emergency Loco with oxygen supply for engine

Excavator with lifting equipment for compressed air tunnelling, Metro Karlsruhe, Germany

TUNNELLING
IS OUR
BUSINESS

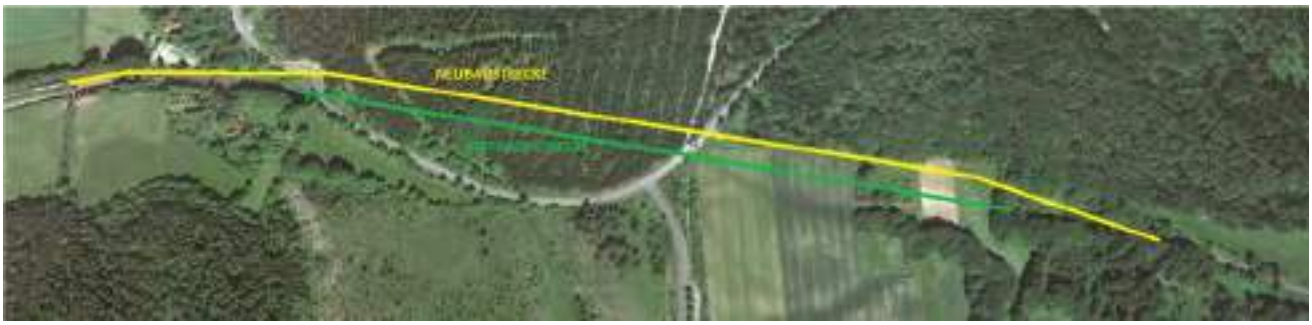
Project Data Sheets

Selection of Underground Construction & Tunnelling Projects

Lainzertunnel, Vienna, Austria

PROJEKTDATENBLATT

RECONSTRUCTION TUNNEL ZIERENBERG



Quelle Bild links: Deutsche Bahn, http://bauprojekte.deutschebahn.com/imagefly/w216-h165-c-q75/media/projects/284/gallery/Zierenberger_Tunnel.jpg

Client:

DB Projektbau GmbH, Frankfurt, Germany

Geology:

Nature park Habichtswald
Claystone and upper bunter sandstone

Contractor:

BeMo Tunnelling GmbH (BeMo)

Project Location:

Zierenberg, Hessen

Start of Construction: May 2015

End of Construction: February 2018

Project Total Value:

21.497.058 € (net.)

Technical Data:

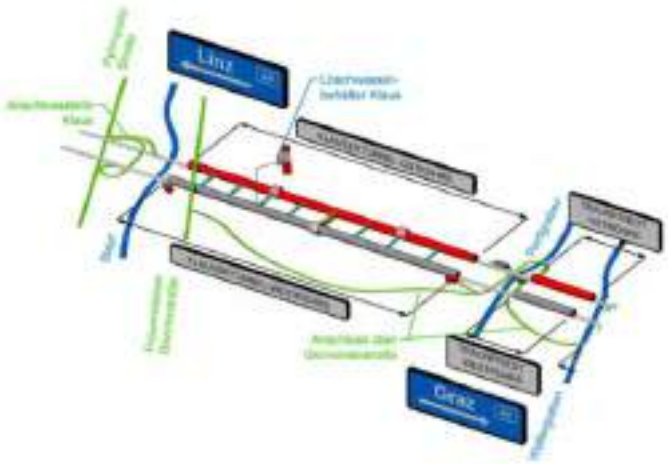
Reconstruction Tunnel Zierenberg, construction of a single-track railway tunnel, parallel construction in the vicinity of the existing old tunnel.

Length ofTunnel:	936 m
Excavation material:	114.000 m³
Mining technology:	871 m
Declination max.:	12 ‰
Cut & Cover method	ca. 65 m
Coverage max.:	3 – 60 m

Excavation: drill and blast, excavator
Execution: reinforced waterproof cast-in-situ secondary lining, NATM, driving mostly ascending (West to East) in vicinity to the portals under pipe roofing

PROJECT DATA SHEET

A9 PYHRN MOTORWAY, COMPLETION TUNNELKETTE KLAUS LOT 4, TUNNELS KLAUS AND TRAUNFRIED



all graphics: ASFINAG / http://www.asfinag.at/unterwegs/bauprojekte/oberoesterreich/-/asset_publisher/1_47143/content/a-9-pyhrn-autobahn-vollausbau-tunnelkette-klaus

Client:

Autobahnen- und Schnellstraßen-Finanzierungs-Aktiengesellschaft (ASFINAG)

Geology:

Northern Limestone Alps
Mainly carbonate rocks of the middle and upper Trias.

Predonderant nature of mountain:
Hillside debris/rubble (little in portal area); dolomite (ranging from low to heavily fragmented), Limestone (bulky up to heavily fragmented);
Shale / clay marl,

Contractor:

BeMo Tunnelling GmbH (BeMo) (technical sponsor)

50% in JV with Wayss & Freytag Ingenieurbau AG (commercial sponsor)

Project Location:

Klaus a. d. Pyhrnbahn, Austria

Start of Construction:

April 2015

End of Construction:

structural works: January 2017
opening for traffic: September 2017

Project Total Value:

31,000,000 €

Technical Data:

Completion Tunnelkette Klaus:

Completion of the A9 Pyhrn-motorway with creation of the tunnels Klaus and Traunfried, construction of the tunnel entrances and adaptation of the service turnaround lane Pertlgraben.

Lot 4:

Tunnel Klaus Easttube total length: 7,106 ft/2,166 m
Intermediate heading Frauensteinerstraße North Portal, Open cut tunnelling North (91+229 ft/28+70 m), Cut & Cover method (36 m/118 ft), Mining technique (1,857m/6,092.5 ft), tunnelroof already driven (emergency escape), bench and invert excavation, interior works

Tunnel Traunfried Easttube total length: 2,467 ft/752 m
Roof, bench and invert excavation, interior works
In addition: Electro-technics, remodelling of the Klaus elevated tank, fire water supply, operating stations and collectors, water pollution control facility

The bridges (lots 1-3) and road works (lot 7) are built either in advance or simultaneously to the tunnel objects.

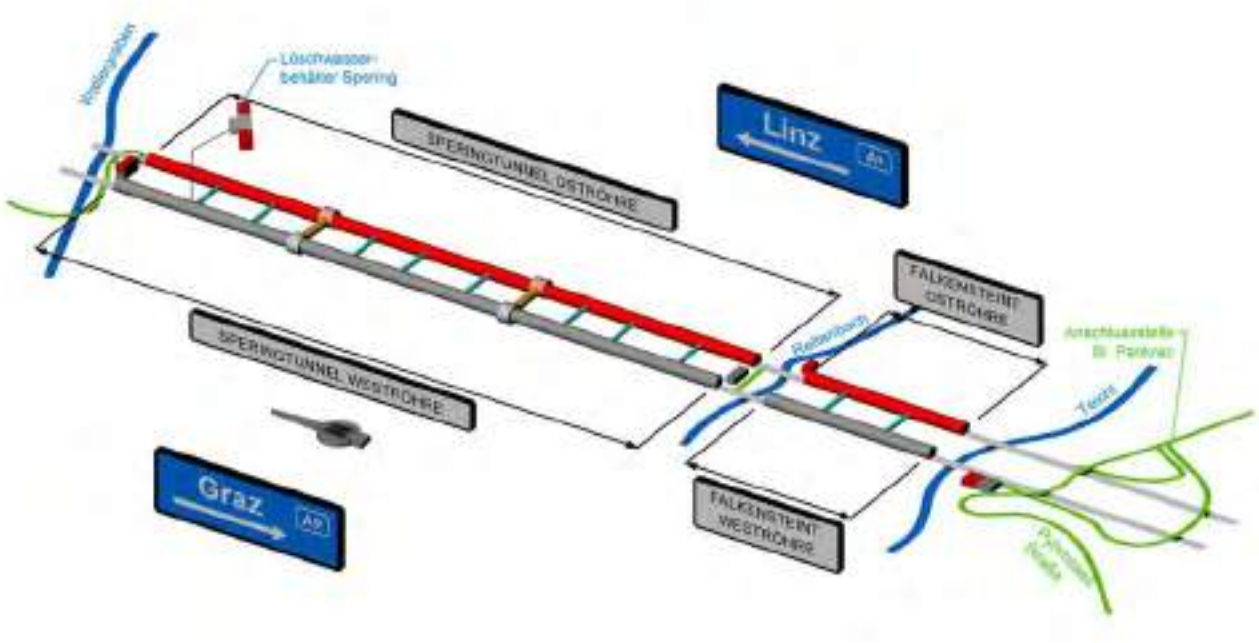
PROJECT DATA SHEET

GEMEINSCHAFTSKRAFTWERK INN – CONSTRUCTION LOT PENSTOCK AND POWERHOUSE PRUTZ/RIED MAIN CONSTRUCTION WORKS

Client: GKI Gemeinschaftskraftwerk Inn GmbH, Landeck, Austria	**Geology:** granite gneiss (white slate lenses embedded)
Contractor: BeMo Tunnelling GmbH (deputy technical sponsor) 26% in JV with: G. Hinteregger & Söhne Baugesellschaft m.b.H. (technical sponsor), Östu-Stettin Hoch- und Tiefbau GmbH (commercial sponsor), Wayss & Freytag Ingenieurbau AG (deputy technical sponsor)	**Technical Data:** • Closed underwater canal, length 310 m • Powerhouse l/w/h 34/23, (32)/34, 8 m for two vertical machine units, Drilled pile shaft with underwater concrete slab, Powerhouse shaft in reinforced concrete with crane-shed on the surface. • Power penstock: inclined shaft, inner diameter 3,80m, length 380m with a 31% slope, 40m flat track, conventional drive with backfilled steel segments • Surge chamber: inner diameter shaft 13,8 m height 100 m, with membrane and in-situ concrete inner lining, length top chamber 70 m, cross-section 35 m² • Unit chamber (at intersection surge chamber/power penstock/reverse drive head race tunnel) with access tunnel, 320 m • conventional reverse drive head race tunnel, excavated diameter 6,50 m, length 1000 m with in-situ concrete lining • with all secondary work, power transmission, access roads and traffic assignment
Project Location: Prutz / Ried, Tyrol, Austria	
Start of Construction: 2014 **Projected end of Construction:** 2018	**Other Project Specific Information:** All works without electrical and mechanical equipment and without hydraulic steel structures for the components.
Project Total Value: 56,402,128 € (share BeMo: 12%)	

PROJECT DATA SHEET

A9 PYHRN MOTORWAY, COMPLETION TUNNELKETTE KLAUS LOT 5, SPERING- AND FALKENSTEINTUNNEL



graphic: ASFINAG

Client:

Autobahnen- und Schnellstraßen-Finanzierungs-Aktiengesellschaft (ASFINAG)

Geology:

Northern Limestone Alps
Mainly carbonate rocks of the middle and upper Trias.

Predonderant nature of mountain:
Hillside debris/rubble (little in portal area); dolomite (ranging from low to heavily fragmented), Limestone (bulky up to heavily fragmented);
Shale / clay marl, Windischgarstener disturbance (mainly Speringtunnel)

Contractor:

BeMo Tunnelling GmbH (BeMo) (TGF)
50% in JV with Wayss & Freytag Ingenieurbau AG (KGF)

Project Location:

Klaus a. d. Pyhrnbahn, Österreich

Start of Construction:

November 2014

End of Construction:

structural works: October 2016
opening for traffic: September 2017

Project Total Value:

35,000,000 €

Technical Data:

Completion Tunnelkette Klaus:

Completion of the A9 Pyhrn-motorway within km 27.9+40 and 36.5+50 with creation of additional escape and emergency ways while ongoing traffic.

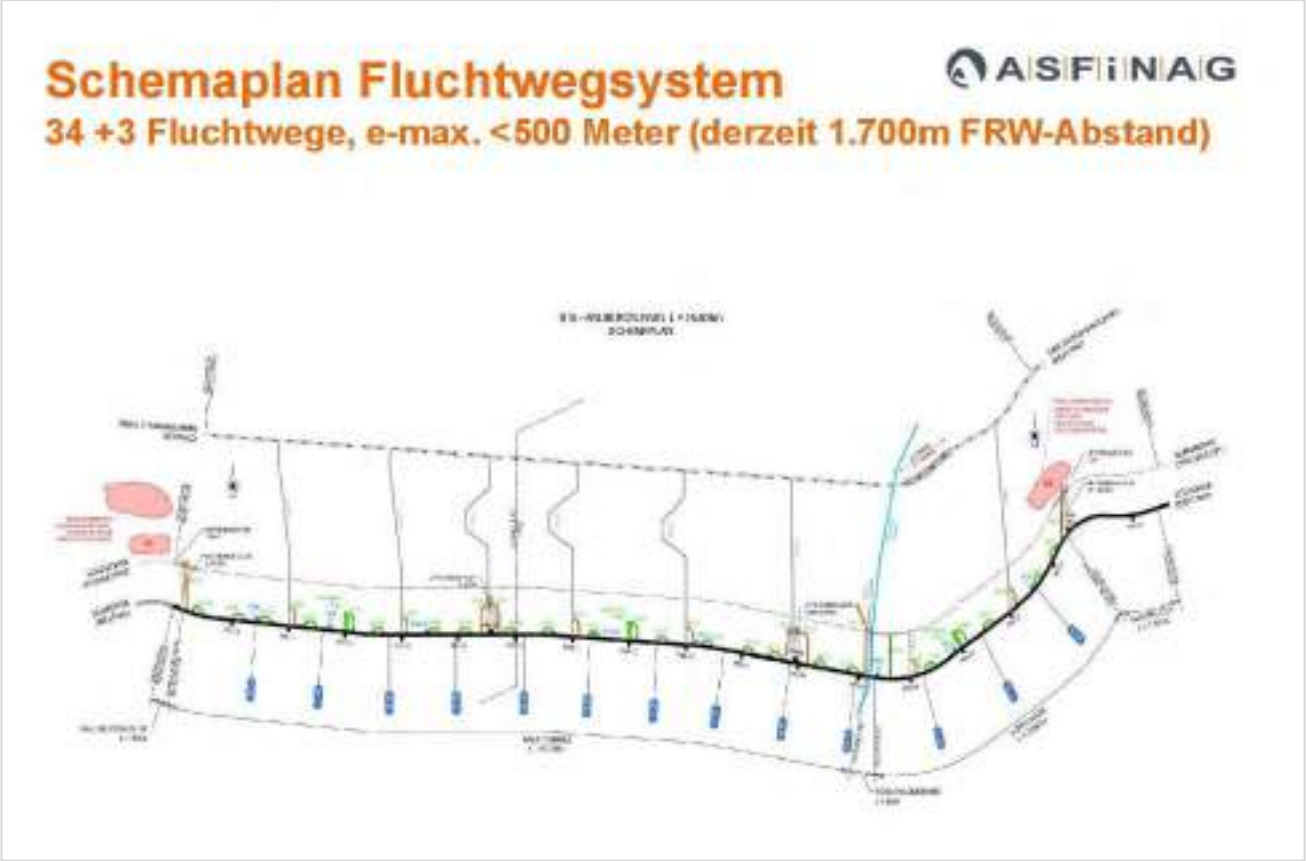
Lot 5:

Speringtunnel Easttube total length: 2,894 m
- Bench and invert excavation on the total length
- Enlargement of two breakdown bays length: 40 m
- Removal of the existing base profile
- Interior Construction
- 8 accessable cross passage Ø 9,84 m
  2 with emergency vehicle accessable

Falkensteinstunnel Easttube total length: 752 m
- Excavation and securing (on overall cross-section)
- Interior Construction
- 2 accessable cross passage Ø 9,84 m

PROJECT DATA SHEET

REDEVELOPMENT ARLBERG ROAD TUNNEL



Client: ASFINAG (Autobahn- und Schnellstraßen-Finanzierungs-AG)	**Geology:** Unconsolidated colluvium, Unconsolidated Sediment, Mica Slate, Phylite, Slate, Gneis
Contractor: BeMo Tunnelling GmbH (Co-technical sponsor construction) Joint venture with PKE Verkehrstechnik GmbH (technical and commercial sponsor of joint venture), Jäger Bau GmbH (technical sponsor construction), G. Hinteregger & Söhne Baugesellschaft m.b.H. (commercial sponsor construction)	**Technical Data:** Partial redevelopment 1 and escape routes via fresh air supply The project contains all construction works for the partial redevelopment of the Arlberg road tunnel as well as the construction of new escape routes via the fresh air supply, additionally breakdown bays and further structural facilities as well as the electromechanical redevelopment of the entire tunnel and re-equipment of the escape routes.
Project location: St. Jakob und Langen a. Arlberg / Austria	
Start of Construction: September 2014 **Projected end of Construction:** November 2017	**Other Project Specific Information:** Design and Built Contract including E&M and implementation planning
Project Total Value: 130.614,290 € (share BeMo: 18,97%)	

PROJECT DATA SHEET

REINSTATEMENT OLD BEBENROTH TUNNEL

Client:

DB Netz AG Hannover, DB Projekt Bau GmbH, RB Nord

Contractor:

JV BeMo Tunnelling GmbH / STUTZ GmbH

BeMo Tunnelling: 90% (TGF)

STUTZ: 10% (KGF)

Project Location:

Frankfurt/Main - Göttingen, Witzenhausen between Eichenberg and Oberrieden, Hessen, Germany

Start of Construction: September 2013

End of Construction: April 2016

Project Total Value:

16,205,000 €

Geology:

Middle (approx. 40%) and upper colorful sandstone (approx. 15%), lower-middle and upper muschelkalk (approx. 35%), lower Keuper (approx. 10%);

Technical Data:

Renewal of the existing 2 line track railway tunnel under total closure of traffic; deconstruction to a single line railway track
(km 222,5+00 – 223,4+36)

Length of tunnel:	936.00 m
Backfilling/injection of cavities:	6,500.00 m³
Removal of existing tunnel construction:	70.00 m³
Shotcrete:	4,000.00 m³
Tunnel excavation:	6,300.00 m³
Shotcrete invert arch:	3,000.00 m³
Secondary lining:	12.500,00 m³
Reinforced concrete secondary lining:	1,100.00 t
Adjustment of track in front of tunnel	600.00 m

Excavation: invert drift by excavator

Execution: construction of a new invert and a new reinforced concrete secondary lining

PROJECT DATA SHEET

POWER PLANT - TAUERNMOOS EXPLORATORY GALLERY

Client:

ÖBB Infrastruktur AG
GB Energie

Contractor:

BeMo Tunnelling GmbH

Project Location:

Tauernmoos, Stubachtal, 5723 Uttendorf, Land Salzburg

Start of Construction: August 2013

End of Construction: August 2014

Project Total Value:

3,000,000 €

Geology:

Granite

Technical Data:

Construction site entry on 2.037m above sea level

Length:	804m
Cross section:	37,26m² resp. 42,41m²
Downward drift:	12%
Protection:	10cm shotcrete with plastic fibres
	anchoring if necessary
Ingress of water:	6-7ltr/sec
Excavation:	drill & blast
Exploratory drilling:	approx. 290m incl. geotechnical experiments

Other Project Specific Information:

Construction site exposed within high alpine surrounding (2.037m above sea level)

PROJECT DATA SHEET

STUTTGART 21, PA 1.5, LOT 3, BAD CANNSTATT TUNNELS

Client:

DB Netz AG

DB Projekt Bau GmbH, Stuttgart, Germany

Contractor:

BeMo Tunnelling GmbH (BeMo)
commercial sponsor in joint venture
30% in JV "Tunnel Cannstatt S 21" (Hochtief - BeMo - Wayss&Freytag)

Project Location:

Stuttgart 21, PA 1.5, Lot 3, Bad Cannstatt, Stuttgart, Germany

Start of Construction: 2012

Projected Duration: 2018

Project Total Value:

290,000,000.00 €

Geology:

Gypsum keuper
Cover (intercity railway: 8m – 10m; interurban railway: 4m – 22m)

Technical Data:

Tunnel (single- and double-track) incl. branch-off structure, connection structure with lengths > 100 m (total length approx. 630 m), 1 smoke extraction structure, emergency gallery with connecting gallery, branch-off structure and crossing structure, emergency access and two intermediate headings, underpassing existing buildings and bridges
A large portion of the tunnel was built as side wall drafts.

Total length:	approx. 7,950 m
Tunnel length mining technology:	approx. 7,300 m
Tunnel length cut & cover:	approx. 650 m
Smoke extraction structure (depth):	approx. 40 m

Excavation by SEM/NATM, excavator in soft ground with shotcrete support and excavation in multiple drift sequences (side-wall drifts) with ground conditioning and pre-support where needed (pipe roofing / pipe arch canopy), partly excavation by drill & blast, cut & cover

PROJECT DATA SHEET

PUMMERSDORFER TUNNEL, SURFACE ROUTE, LOT GUM4

Client:

ÖBB-Infrastruktur AG – GB Neu - und Ausbau

Contractor:

BeMo Tunnelling GmbH (BeMo)

Project Location:

Freight railway bypass St. Pölten, GZU-Mitte, closure of the gap St. Pölten - Loosdorf, Austria

Start of Construction: January 2012

Projected Duration: December 2014

Project Total Value:

74,500,000.00 €

Technical Data:

Double-track railway tunnel, 1 tube with emergency exits and open track
New line total length: 12,800 m (Km 3.0+00 – Km 15.8+00)
Total length Tunnel: 3,485 m (Km 10.8+62 – Km 14.3+47)
Mining: 3,445 m (rising 3.4‰ West – -East)
Cross section: approx. 120 m² (≈ 410,000 m³)
6 Emergency exits with galleries (14 m, 870 m³) and shafts (18-30 m, Ø ≈ 8.50 m (≈ 10,100 m³) with waterproof execution
Cut & cover (East-/West portal) à 20 m cut & cover incl. portal blocks as "Weisse Wanne" (2 x 10 m blocks)

Excavation: drill and blast, soft material with excavator, 400 m underneath pipe roofing, 24 m pipe roofing East-/West portal

Design: NATM, cast-in-situ concrete lining (30 cm, unreinforced), inner lining with membrane lining (PVC), junction areas (reinforced), invert arch (unreinforded resp. in area of mass-spring-system with reinforced waterproof inner lining of base slab (200 m))

Surface route: construction of the track substructure, ballast, slope protection, signal installations, telecommunication system and energy supply system, streets and roads (new construction, adaption and transfer), drainage works, noise barriers (10,144 m, H=1,5-6m, ≈ 32,575 m²) & walls (4,669 m, H=2-4,8m), landscaping works, constructive engineering (retention chambers, noise barriers special constructions), transfer of channels and other constructions of third parties, removal of buildings, extinguishing water-supply pipe (portal area and A3)

Geology:

Molasse", "Schlier" (fine sand silt and claystone alternating with fine sand and marl layers), sandstone, sheet gravel, vertical clefts between "Schlier" and gravel, loam, arey by area cementation zones

Ground water (gravelly-sandy horizons) , cleft ground water in "Schlier", up to 10 l/s entries of cleft ground water between East portal and km 11.80, water carrying gravel between km 12.1+60 and 13.0+70, ridge rain possible

Other project specific information:

- cover: 15-22m
- 2 valley-like incised depressions, ridge cover 9-12 m
- Only machines that work with biodegradable lubricants and hydrolic oils are used

PROJECT DATA SHEET

LIMESTONE QUARRY STEYRLING




Client:
Voestalpine Stahl GmbH

Contractor:
BeMo Tunnelling GmbH

Project Location:
Steyrling, Austria

Start of Construction: March 2012

Projected Duration: September 2012

Project Total Value:
4,000,000.00 €

Geology:
Limestone

Technical Data:

Shafts, caverns and galleries for a limestone quarry

Total shaft length:	1,360 m
Shaft 1 – Depth:	161.5 m (Ø = 3.7 m)
Cavern 1 (L x B x H):	20 x 10 x 10 m
Gallery 1:	210 m (20 m²)
Double Shaft (No. 2 and 3 parallel)	
Shaft 2 –Depth:	163 m (Ø = 3.7 m)
Shaft 3 – Depth:	161.5 m (Ø = 3.7 m)
Cavern 2 (L x B x H):	42 x 10 x 10 m
Gallery 2:	297 m (24 m²)

Excavation: drill & blast
Design: galleries and caverns - NATM, Shafts - raise-boring

PROJECT DATA SHEET

REFURBISHMENT / REINSTATEMENT OF OLD SCHLÜCHTERNER TUNNEL

Client:

DB Netz AG, DB ProjektBau GmbH, RB Mitte

Contractor:

BeMo Tunnelling GmbH

Project Location:

Rail line 3600, Frankfurt/Main – Göttingen, „Kinzigtal line“, Kinzigtal, Schlüchtern - Flieden, Germany

Start of Construction: July 2011

Projected Duration: March 2014

Project Total Value:

40,600,000 €

Geology:

Sandstone (lower triassic, “Mittlerer Buntsandstein” (ca. 50%), “Oberer Buntsandstein“), Tertiary; southern portal area and northern half of the tunnel below the ground water table

Technical Data:

Enlargement, refurbishment and reconstruction of an existing double-track railway tunnel under full closure of operation (future single-track tube), (km 76.7+68 - 83.1+80), construction of 4 connection structures between Old and New Schlüchterner Tunnel, 60 m extension at the North side using open cut method

Tunnel length:	3,576 m
Excavated volume:	13,500 m³
Invert arch shotcrete:	37,000 m²
Secondary lining:	35,500 m³
Reinforcement steel secondary lining:	4,390 t
IBO self-drilling bolts:	23,100 m
Construction of 4 escape galleries – total:	120 m
Adaption of tracks outside the tunnel – ca.	600 m
New noise barrier:	550 m

Excavation: Invert excavation – excavator

Design: Construction of a new invert arch and a new reinforced secondary lining

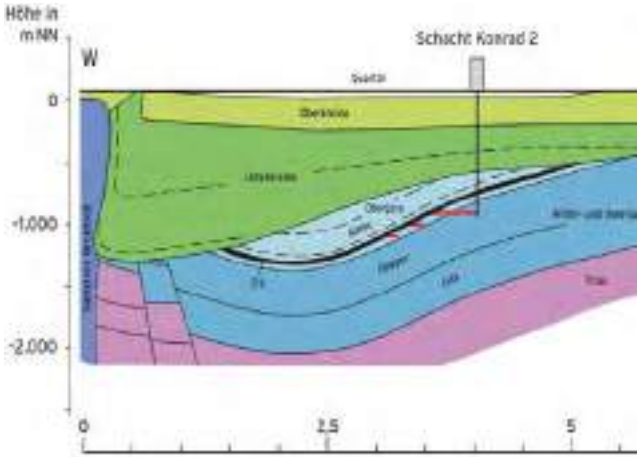
PROJECT DATA SHEET

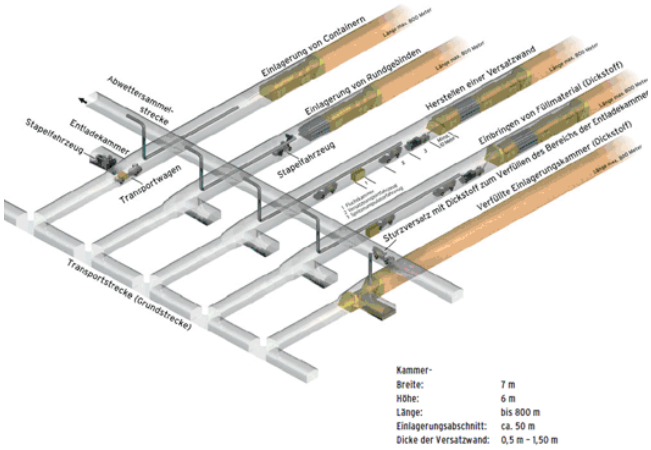
C510 WHITECHAPEL AND LIVERPOOL STREET STATIONS TUNNELS

Client: Crossrail Ltd., London, UK (wholly owned subsidiary of Transport for London (TfL))	**Geology:** London clay
Contractor: BeMo Tunnelling GmbH (formerly: Beton- und Monierbau) in Joint Venture 10% in BBMV JV (Balfour Beatty, Morgan Sindall and Vinci)	**Technical Data:** Construction of tunnels and shafts for two new underground railway stations (inner city) Crossrail Contract C510, Early Access Shafts and Sprayed Concrete Lining Works for Whitechapel and Liverpool Street stations tunnels comprises The works at C510 comprise the construction of the Crossrail Liverpool Street Station and Whitechapel Station SCL tunnels, construction shafts and adits, platform tunnels, Tunnel Boring Machine (TBM) reception chambers and launch chambers, cross passages, access passages, escalator barrels, ventilation ducts, and a link passage from the Crossrail Liverpool Street Station to the London Underground (LU) Northern Line Moorgate Station platforms. The works also include the construction of six compensation grouting shafts in the vicinity of Liverpool Street station works and one in the vicinity of Whitechapel station works. Methods: SCL, Shotcrete Tunnelling, LaserShell™ using TunnelBeamer™
Project Location: London, UK	
Start of Construction: January 2011 **Projected Duration:** September 2017	
Project Total Value: 600,000,000.00 € (GBP 235m, NEC3 base tender value)	**Other Project-Specific Information:** • Structural Analysis and design work for execution of primary lining (shotcrete – sprayed concrete lining) and participation in OCI-Phase (Optimised Contractor Involvement) by BeMo's Tunnel Design Dept. • Partnering Project (NEC3-Contract, Option C, Target contract with activity schedule)

PROJECT DATA SHEET

FINAL STORAGE KONRAD (LOT 3 & 5)





Client:

Deutsche Gesellschaft zum Bau und Betrieb von Endlagern für Abfallstoffe mbH (DBE), Salzgitter

Contractor:

BeMo Tunnelling GmbH (BeMo)
commercial sponsor in JV
50 % in JV "ELK" (BeMo-Operta)

Project Location:

Salzgitter-Bleckenstedt, Germany

Start of Construction: 2011

Projected Duration: 2015

Project Total Value:

40,750,000 €

Geology:

Iron-ore (Korallenoolith Upper Jurassic – Malm ca. 800 – 1,300 m depth), Claystone (Lower Jurassic), marl- and limestone (Upper Jurassic)

Technichal Data:

Mine excavations, storage chambers, storage ways and borings for the modification of BW Konrad into a final storage

Storage chambers:	ca. 1,880 m
Unload chambers:	ca. 33 m
Access roads to chambers:	ca. 400 m
Upcast airways:	ca. 370 m
Enlargements:	ca. 370 m
Bore holes DN 800:	ca. 61 m (raiseboring)
Bore holes DN 1400:	ca. 200 m (raiseboring)

Excavation: roadheader

PROJECT DATA SHEET

LOT 2 – HEADRACE STRUCTURES, NEW HYDROPOWER PLANT FINSING

Client: TIWAG-Tiroler Wasserkraft AG	**Geology:** Massive rock, Wildschönau slate, soil
Contractor: BeMo Tunnelling GmbH (BeMo)	**Technical Data:** Construction of headrace structures (adaption of existing headrace gallery, new connection gallery and surge chamber shaft, inclined shaft and penstock) The two hydropower plants which were built in the 1920s have been combined to a single step hydropower plant. The standard capacity (SC) of the new hydropower plant at medium water level is 20.91 GWh per year. Tunnel length: ca. 900 m (inclined shaft and penstock) Penstock: 635 m Surge Chamber Shaft: 44.25 m (ø 6 – 8.8m) Inclined Shaft: 215 m (ø 1.4 m, 50° inclined, raiseboring) Connection Gallery (Shaft floor – existing water gallery): 53 m (5.9 m²) Excavation: Drill and blast (galleries and cavern), raiseboring (inclined shaft), shaft sinking (surge chamber shaft) Design: NATM, shotcrete lining using wire mesh, steel fibers were used instead of wire mesh in geologically suitable classes, in-situ concrete lining, additionally reinforced shotcrete lining instead of secondary lining in geologically sensitive upper area of the surge chamber shaft (proposed by BeMo) Concreting of wear-resistant layer steel pipes and penstock using the tremie method Hydraulic steel structures: steel pipes (each 12-m-long, DN 1000) laid top-down in the inclined shaft, coupled to the lower manifold
Project Location: Finsing, Uderns and Fügenberg, Zillertal, Austria	
Start of Construction: September 2011 **Projected end of Construction:** September 2012	
Project Total Value: 6,300,000.00 €	

PROJECT DATA SHEET

TUNNEL SCHULBERG

Client:

Department for roads and traffic Kassel(„Amt fuer Strassen und Verkehrswesen"), Kassel, Germany

Contractor:

BeMo Tunnelling GmbH (BeMo)
(formerly: Beton- und Monierbau)

Technical Sponsor in Joint Venture

80% in JV Schulbergtunnel (BeMo-Stutz)

Project Location:

BAB A44 Kassel – Herleshausen,
Hessisch Lichtenau, Germany

Start of Construction: February 2010

Projected End of Construction: December 2012

Project Total Value:

37,252,000 €

Geology:

Weathered middle lacustrine limestone („Mittlerer Muschelkalk") with karst formations, weathered ceratitida layers, weathered lower keuper, weathered to highly weathered middle keuper

Technical Data:

- Double-lane motorway tunnel, 2 tubes
- Total length of tunnel: 2 x 687 m
- 2 x 360 m excavation by excavator, drill and blast
- Execution by NATM (water-pressure tight)
- 2 x 327 m cut & cover tunnel (piles)
- 2 Crosspassages (1 for emergency vehicles)
- 1 lay-by enlargement
- 800 m open cuts and dams
- earthworks

Other Project-Specific Information:

- Structural Analysis and Detailed Design (work & as-built drawings) by BeMo (Tunnel Design Department)
- Excavation Tunnel: Nov – Apr only
- Construction cut & cover section: May – Oct only

PROJECT DATA SHEET

NEW BEBENROTH-TUNNEL

Client:

DB Netz AG
DB Projekt Bau GmbH, RB Nord, Hannover, Germany

Contractor:

BeMo Tunnelling GmbH (BeMo)
(formerly: Beton- und Monierbau)
technical sponsor in joint venture
70% in JV "Bebenroth-Tunnel" (BeMo - Stutz)

Project Location:

rail line 3600, Frankfurt (M) Bebra-Göttingen, Witzenhausen, Germany

Start of Construction: January 2010

start of implementation design: January 2010
start of works on site: March 2010

Projected End of Construction: December 2012

Project Total Value:

24,200,000 €

Geology:

Sandstone (lower triassic, "Mittlerer Buntsandstein"), Sandstone ("Röt" oberer Bundsandstein), lower/middle/upper lacustrine limestone, lower keuper, quarternary; (7 fault zones)

Technical Data:

- Single track railway tunnel (1 tube) & connection structure
- Total length of tunnel: 1,030 m
  - Mined: 970 m
  - Cross section: 78 – 85 m²
- Connection structure: 134 m
  - Cross section: 15 m²
- Excavation by drill and blast, excavator, 0,8% desc.
- Execution by NATM
- Earthworks, Materials Management

Other Project-Specific Information:

- Structural Analysis and Detailed Design (work & as-built drawings) by BeMo's Tunnel Design Department, Innsbruck, Austria

PROJECT DATA SHEET

METRO „STADTBAHNTUNNEL“ KARLSRUHE

Client:

Karlsruher Schieneninfrastruktur-GmbH (KASIG), Karlsruhe, Germany

Contractor:

BeMo Tunnelling GmbH (BeMo)

Project Location:

Karlsruhe, Germany

Start of Construction: April 2010

Tunnelling Works: February 2013 – March 2014

Projected End of Construction: June 2016

Project Total Value:

313,000,000 € (incl. tunnelling: 70,000,000 €)

Geology:

Gravely-sandy sediments, cohesive penetrated sands, clays and clay-sand-mixtures, soil, 4 – 8 m overburden

Technical Data:

- Construction of KASIG’s 4.6 km metro project “Stadtbahntunnel” including 3.9 km tunnels (incl. Cut & Cover), 7 underground stations („Europaplatz“, „Lammstrasse“, „Kronenplatz“, „Durlacher Tor“, „Marktplatz“, „Ettlinger Tor“, „Kongresszentrum“), 8 stations including interior works: “Helmholtz-Gymnasium und Grashofstrasse”, “Kaiserstrasse West”, “Europaplatz”, “Durlacher Allee”, “Bernhardusplatz”, „Gottesauer Platz“, „Augartenstrasse“
- Tunnel Kaiserstrasse (double-track): 2,050 m
  - Hydroshield Ø 9.3 m, lining with concrete segments
- Tunnel Karl-Friedrich-Strasse (double-track including triple-track enlargements): 250 m
  - Shotcrete-method (NATM) using compressed air, Cast-in-situ concrete lining
  - Cross-section: 70 - 170 m²
- Tunnels and ramps using open cut method (Ramp „Muehlburger Tor“, Ramp „Durlacher Allee“, Tunnel „Ettlinger Strasse“ (Ettlinger Tor – Kongresszentrum), Ramp „Ettlinger Strasse“
- Foundation Engineering
- Track, road and sewer construction
- Structural Analysis and Detailed Design (work & as-built drawings) by BeMo’s Tunnel Design Department

PROJECT DATA SHEET

EXPLORATORY GALLERY LÄNGENTAL, HEP KUEHTAI II

Client:

Tiroler Wasserkraft AG (TIWAG), Innsbruck, Austria

Contractor:

BeMo Tunnelling GmbH (BeMo)

Project Location:

Kuehtai, Tyrol, Austria

Start of Construction: July 2010

Excavation Gallery: 1 Aug – 22 Oct. 2010

Reconnaissance Drilling: 15 Nov. 2010

Projected Duration: July 2011

Project Total Value:

2,200,000 €

Geology:

Old-crystalline Oetztal Alps Group (slate gneiss, band-gneiss, amphibolite)

Technichal Data:

- Exploratory gallery for Powerhouse Cavern Kuehtai II
  - Tunnel length of gallery: 735.00 m
  - Cross-section: 12.50 m²
- 2 additional galleries for radial press test 20.00 m
  - Cross-section: 4.50 m²
- Enlargements for drilling (3 x) 45.00 m
  - Cross-section: 21.50 m²
- 660 m invert arch
- Excavation: drill and blast
- Execution: SW anchors, partly with shotcrete

Other Project-Specific Information:

- 13 reconnaissance drillings up to 150 m starting from the enlargements, total drilling meters: 1,100 m;
- High alpine site at 2,000 m above sea level

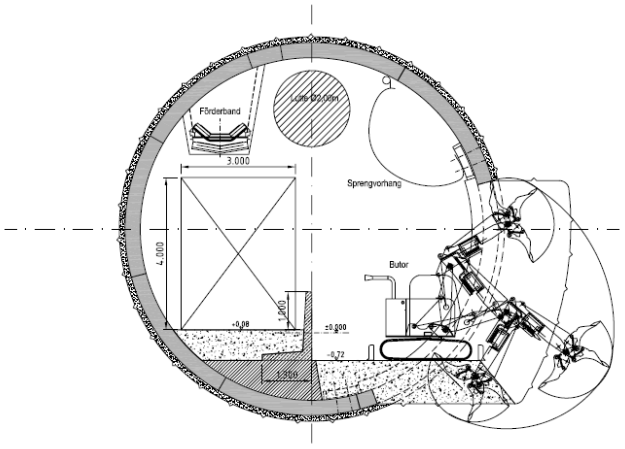
PROJECT DATA SHEET

BOSRUCKTUNNEL, SECOND TUBE

Client: ASFINAG Bau Management GmbH Design: Laabmayr - ILF Joint Venture / Supervision: Geoconsult ZT	**Geology:** Carbonate, sandstone, marl, conglomerate, „Haselgebirge“, „Werfener“ layers, anhydrite, dolomite
Contractor: BeMo Tunnelling GmbH (BeMo)	**Technical Data:** • Double-lane motorway tunnel, construction of 2nd tube • Total length of tunnel: 17,799 ft (5,425 m) o Excavation: 17,372 ft (5,295 m) o Cross-section: 979.52 – 1,442.36 SF (91 - 134 m²) o 5 Lay-by enlargements length each: 167 ft (51 m) o Cross-section enlargements: up to 1,615 SF (160 m²) • 11 Crosspassages - CPs (each GQ and EQ): 203 ft (65 m) o 5 CPs for emergency vehicles (EQ): ca. 646 SF (60 m²) o 6 CPs walkable / pedestrian (GQ): ca. 484 SF (45 m²) • Excavation by drill & blast 15,600ft (4,755m), excav. 1,772ft (540m) • Execution by NATM, in-situ concrete secondary lining
Project Location: A9 Pyhrn Motorway, Spital am Pyhrn, Austria	
Start of Construction: January 2010 **End of Construction:** October 2013	
Project Total Value: 127,400,000 €	**Other Project-Specific Information:** • Material management incl. disposal: 27,192,293 ft³ (770,000 m³) total excavated, 11,124,120 ft³ (315,000 m³) to be reused for the heavy duty car-park Phyrn Priel • Continuous/ongoing refurbishment works in the existing east tube during the period of construction • 2 ventilation galleries (LQ), 91 niches (43 emergency NLN + 48 extinguisher FLN), structures above ground (operation building north / south with elevated tank), heavy duty car-park Phyrn Priel

PROJECT DATA SHEET

NEW KAISER-WILHELM-TUNNEL (NKWT)

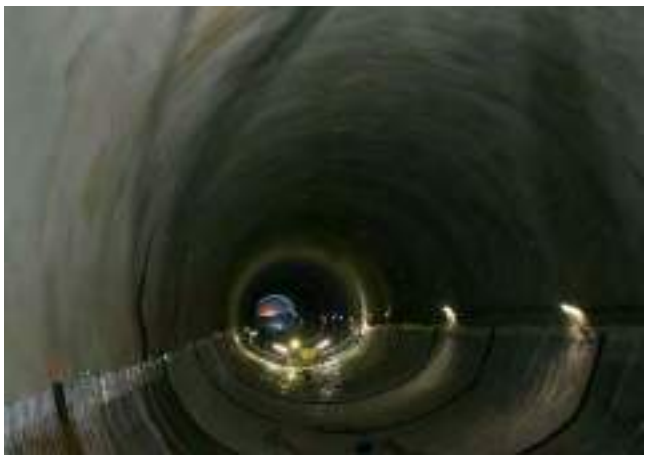


Client: DB Netz AG DB Projekt Bau GmbH, RB Mitte, Frankfurt/Main, Germany	**Geology:** Mainly Quarternary Sediments, talus material (soil), clay and rock (clay-slate, siltstone, fine sandstone with quartzite banks), water pressure approx. 3 bar
Contractor: BeMo Tunnelling GmbH (BeMo) sponsor in joint venture 82% in JV "NKWT" (BeMo - Alpine Bau Dt. AG - FCC)	**Technical Data:** • Single-track railway tunnel, 1 tube • Total length of tunnel: 13,917.32 ft (4,242 m) o Carinthian cut & cover South portal: 65.62 ft (20 m) o Cross section: 862.40 SF (80.12 m²) • 8 Cross-passages to the Old Kaiser-Wilhelm-Tunnel with diverse cross-sections (15 – 25 m²) • Excavation by TBM (EPB Ø=10,15 m), cross-passages and starting-section by excavator, partly preparatory blasting (vibrations <10mm/s allowed) • Spoil removal (rail only) limited to 1.000 m³/day • Execution by TBM (EPB), lining with pre-cast concrete segments, starting-section by carinthian cut & cover method, NATM • Sinking of shafts Ø approx. 6.5 m / depth approx. 13.0 m • Grouting in the area of low cover (3,5 m) • Cut & Cover approx. 40 m
Project Location: Rail line 3010, "Mosel line" Koblenz – Trier Ediger-Eller – Cochem/Mosel, Mosel river area, Germany	
Start of Construction: July 2009 **Projected End of Construction:** 2012	
Project Total Value: 78,587,200.00 €	**Other Project-Specific Information:** • Structural Analysis and Detailed Design (work & as-built drawings) by BeMo's Tunnel Design Department • Parallel construction in the vicinity of the existing old tunnel • Underpassing the city of Cochem (cover approx. 3 - 28 m)

PROJECT DATA SHEET

VP LICHTENFELS, TUNNEL KULCH & LICHTENHOLZ






Client:

DB Netz AG
DB Projekt Bau GmbH, NL Südost, Erfurt, Deutschland

Contractor:

BeMo Tunnelling GmbH (BeMo)
in joint venture
50% in Tunnel-JV (BeMo - Hochtief)
33.37% in JV „NBS Lichtenfels“ (Hochtief – BeMo – Bickhardt - Stutz)

Project Location:

High-speed rail line Ebensfeld-Erfurt, Germany
(VDE 8.1, NBS Ebensfeld-Erfurt, BA 3110, VP Lichtenfels, Bau-km 9,0+90 - 15,1+44), Bad Staffelstein

Start of Construction: July 2009

Implementation-Design: 06.07.2009
Construction Work: 05.10.2009

End of Construction: 30.09.2013

Project Total Value:

109.979.000 €

Geology:

Tunnel Kulch: clay and marl, limestone-marl alternation (Early Jurassic – „Lias“), quarternary slope loam
Tunnel Lichtenholz: silty clay/marl/limestone (Lias), sandstone and clay with silty layers (Upper Keuper – „Rhaet“, Middle Keuper – “Feuerletten”); Swelling-parameters (Huder-Amberg) 7.5% - 30%

Technical Data:

- Double-track railway tunnels, 1 tube each
- Tunnel Kulch: 1,331 m
  - mining: 1,291 m
  - emergency gallery: 120 m
  - shaft - depth: 14 m
- Tunnel Lichtenholz: 931 m
  - mining: 891 m
- Cross-section: 175 m²
- Excavation by drill and blast, excavator
- Execution: NATM

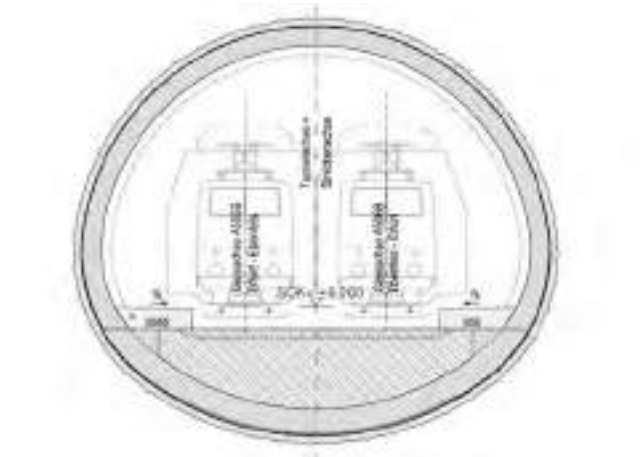
Other Project-Specific Information:

- overburden approx 7 – 27 m
- 175 m rail viaduct (Muehlbachviaduct Untersiemau) and 5 new road bridges (reinforced concrete)
- 1.36 mill. m³ earthworks / 2 mill m³ material mgmt
- groundwater 5 – 25 m above the tunnel crown
- soil stabilisation / structur pillar around 1 km

PROJECT DATA SHEET

TUNNEL BAUMLEITE


Photo: Wolfgang Sitter



Client:

DB Netz AG
DB Projekt Bau GmbH, NL Suedost, Erfurt, Germany

Contractor:

BeMo Tunnelling GmbH (BeMo)
(formerly: Beton- und Monierbau)

Project Location:

High-speed rail line Ebensfeld-Erfurt, Schalkau, Germany

Start of Construction: July 2009

Structural Analysis and Detailed Design since May 2009

Projected End of Construction: December 2011

(approx. 7 months ahead of schedule)

Project Total Value:

47,438,000 €

Final sum expected: 44.300.000 €

Geology:

Lower lacustrine limestone („Unterer Muschelkalk“) with karstic cavities / karst formations

Technical Data:

- Twin-track railway tunnel, 1 tube + 3 emergency exits (2 galleries and 1 shaft)
- Total length of main tunnel: 4,311.02 ft (1,314 m)
  - Cross section: 1345.49 – 1732 SF (125 - 161 m²)
- Emergency shaft and gallery (NA 2):
  - Shaft depth: 131.23 ft (40 m)
  - Cross section: 715.26 SF (66.45 m²)
- 2 emergency galleries with crosspassages to the tunnel:
  - Gallery - parallel (NA 1): 285.43 ft (87 m)
  - 1 Crosspassage (NA 1): 82.02 ft (25m)
  - Gallery - parallel (NA 3): 771.00 ft (235 m)
  - 1 Crosspassage (NA 3): 82.02 ft (25 m)
  - Cross section (NA 1, NA 3): 184 SF (17 m²)
- Excavation by drill and blast, excavator
- Execution by NATM, in-situ secondary lining

Other Project-Specific Information:

- Structural Analysis and Detailed Design (work & as-built drawings) by BeMo’s Tunnel Design Department (started in May 2009)
- Crown of the tunnel 26.25 ft – 98.43 ft (8 m - 30 m) below ground surface

PROJECT DATA SHEET

TUNNEL JAGDBERG

Client:

DEGES
(Deutsche Einheit Fernstraßenplanungs- und Bau GmbH)

Contractor:

BeMo Tunnelling GmbH (BeMo)
(formerly: Beton- und Monierbau)

commercial sponsor in joint venture

50% in Tunnel JV "A4" (BeMo - Baresel)

30.54% in JV "Tunnel Jagdberg" (Baresel – BeMo - Kirchhoff)

Project Location:

A4 Eisenach – Görlitz, AS Magdala – AS Jena-Göschwitz
Jena, Germany

Start of Construction: May 2008

Projected End of Construction: September 2012

Project Total Value:

208,045,373 € (Tunnel, road- and bridge)

127,071,857 € (Tunnel)

Geology:

Sandstone (lower triassic, "Röt", "Buntsandstein"), lacustrine limestone ("Muschelkalk")

Technical Data:

- Triple-lane motorway tunnel, 2 tubes
- Total length of tunnel: 20,157.48 ft (6,144 m)
  - Cross-section: 1345.49 - 1668.41 SF (125 - 155 m²)
- Total length north tube: 10,085.30 ft (3,074 m)
  - Mined section: 9,980.32 ft (3,042 m)
  - Cut&Cover west/east portal: 32.81/72.18 ft (10/22 m)
- Total length south tube: 10,072.18 ft (3,070 m)
  - Mined section: 9,612.86 ft (2,930 m)
  - Cut&Cover west/east portal: 32.81/427 ft (10/130 m)
- 10 Crosspassages (each): 49.21 - 82.02 ft (15 – 25 m)
  - Cross-section: 270-484 SF (25-45 m²)
- 10 Lay-by enlargements length each: 164.04 ft (50 m)
  - Cross-section: 1733 - 2163.55 SF (161 - 201 m²)
- Excavation by drill and blast and NATM excavator
- Execution by NATM
- Ventilation-shaft and -gallery (smoke extraction):
  - Shaft depth: 459.32 ft (140 m)
  - Shaft Ø: 21.98 ft / 379.97 SF (6.70 m / 35.3 m²)
  - Pilot shaft (raiseboring) Ø: 4.9 ft (1.5 m)
  - Shaft sinking Ø: 26.3 ft / 541.4 SF (8 m / 50.3 m²)

PROJECT DATA SHEET

SPILLVATTENTUNNEL LERUM-PARTILLE

Client:

GRYAAB AB, Gothenburg, Sweden

Contractor:

BeMo Tunnelling GmbH (BeMo)
(formerly: Beton- und Monierbau)

Project Location:

Gothenburg, Sweden

Start of Construction: March 2007

Excavation access tunnel: April 2007
Excavation SVT: November 2007

End of Construction: June 2011

Excavation access tunnel: October 2007
Excavation SVT: June 2010

Project Total Value:

approx. 30,000,000 € (SEK 280,021,000)

Geology:

Granodiorite, granitic gneiss, amphibolite

Technical Data:

- Sewer gallery ("Spillvattentunnel" – SVT)
- Total length of tunnel SVT: 8,000 m
- Cross-section SVT: 11 m²
- Access tunnel length: 310 m
- Access tunnel inclination: 14%
- Access tunnel cross-section: 25 m²
- Volume excavation: approx. 100,000 m³
- Execution by drill and blast, comprehensive grouting

Other Project-Specific Information:

- Miscellaneous concrete works, short open cut, enlargements
- Cover to ground level: 5 m – 100 m

PROJECT DATA SHEET

BBT EXPLORATORY GALLERY AICHA-MAULS (B0021)

Client: Galleria di Base del Brennero - Brenner Basistunnel BBT SE	**Geology:** Brixner Granite
Contractor: BeMo Tunnelling GmbH (BeMo) partner in Joint Venture „ATB - Tunnel Brennero“ 0.90% in JV „ATB - Tunnel Brennero“ (Pizzarotti, Condotte, Collini, Seli, Bilfinger Berger AG, Alpine Bau, BeMo and Jäger Bau)	**Technical Data:** • Exploratory gallery for Brenner Base Tunnel (BBT) • Total length of gallery Aicha: 10,400 m o Cross-section: 25 m² • Execution by TBM • Access gallery Mauls: 1,767 m o Cross-section: 35 m² – 92 m² o Declination: 9% • Connection gallery Aicha: 400 m • Execution by drill and blast, NATM
Project Location: Aicha (Natz-Schabs) – Mauls (Freienfeld), South Tyrol, Italy	
Start of Construction: August 2007 Excavation exploratory gallery (TBM): April 2008 Excavation access gallery Mauls: March 2008 **Projected End of Construction:** 2010	
Project Total Value: 85,583,000 €	

PROJECT DATA SHEET

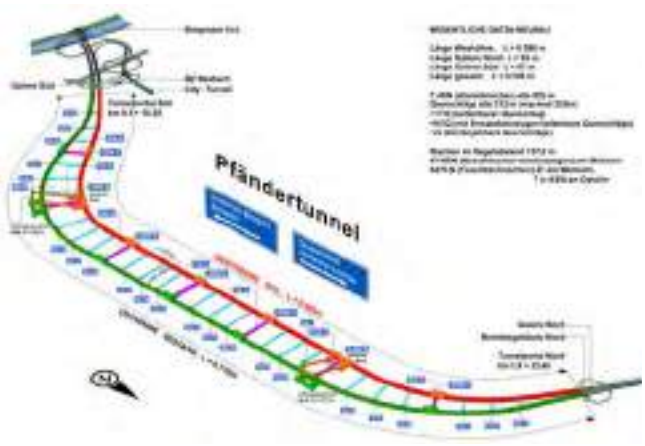
OLD MAINZER TUNNELS MODERNISATION/RECONSTRUCTION




Client: DB Projekt Bau GmbH, NL Mitte, DB Netz AG, Frankfurt/Main, Germany	**Geology:** Silt, clay (tertiary sequence)
Contractor: BeMo Tunnelling GmbH (BeMo) (formerly: Beton- und Monierbau)	**Technical Data:** • Enlargement and rebuilding of two existing double-track railway tunnels under full closure of operation • Length „Mainz Central Station Tunnel“: 662 m • Pipe roofing West/East portal each: 20 m • Length „Mainz South Tunnel“: 246 m • Pipe roofing West portal: 20 m • Carinthian cut & cover East portal: 20 m • Cross-section: 126 m² • Enlargement of existing tunnels (enlargement structure gauge: from 42 m² to 74 m²) using compensation-grouting (radial comprehensive grouting – BeMo special proposal), excavation support with reinforced shotcrete, reinforced waterproof inner lining
Project Location: Mainz Central Station, Mainz, Germany	
Start of Construction: March 2007 **End of Construction:** June 2009	
Project Total Value: 32,060,000 €	**Other Project-Specific Information:** • Structural Analysis and Detailed Design (work & as-built drawings) by BeMo’s Tunnel Design Department • Underpassing partly densely populated area • Renewal of Superstructure (drainage-system and cable lines)

PROJECT DATA SHEET

PFAENDERTUNNEL, SECOND TUBE



Client:

ASFINAG Bau Management GmbH

Contractor:

BeMo Tunnelling GmbH (BeMo)

Project Location:

Rheintalautobahn A14, Bregenz - Lochau, Vorarlberg, Austria

Start of Construction: October 2007

Excavation (soil) - conventional: February 2008

Excavation starting section: April 2008 – September 2008

Excavation TBM: September 2008 – November 2009

Projected End of Construction: February 2013

Project Total Value:

129,985,241 € (net)

Geology:

„Molasse“ consisting of conglomerate, sandstone, marl-sandstone, marl and clay-marl, soil

Technical Data:

- Double-lane motorway tunnel, 1 tube
  - Total length main tunnel: 6,744 m
  - Excavation – soil (mining): 100 m
  - Cross-section: approx. 112 m²
- 31 Crosspassages (CP) approx. 1,500 m
  - 1 CP for vehicles (FQ: 48.84 – 55.74 m²)
  - 6 CPs for emergency vehicles (EQ: 32.4 – 41.5 m²)
  - 24 Crosspassages (GQ – 13.80 – 17.88 m²)
- 7 lay-by enlargements - length: 5 x 40 m, 2 x 80 m
- 4 ventilation caverns: length each 35 m
- 4 inclinded tunnels (32.5%): 29.04 – 37.97 m²)
- Execution by Single Shield TBM, lining with concrete segments, crosspassages and soil by mining, NATM

Other Project-Specific Information:

- First road tunnel in Austria to be built by TBM
- TBM: Ø 11.92 m, 180 m total length, 4,800 kW
- 4 ventilation caverns with 4 inclinded tunnels to the existing ventilation-shafts

PROJECT DATA SHEET

TIERGARTENTUNNEL, H3-6 WIESING–JENBACH EAST

Client:

ÖBB-Infrastruktur AG, GB Unterinntal, Innsbruck, Austria
(formerly: Brenner Eisenbahn GmbH (BEG))

Contractor:

BeMo Tunnelling GmbH (BeMo)
(formerly: Beton- und Monierbau)

commercial & technical sponsor in joint venture

66,66% in JV „Tunnel Wiesing (ATW)“ (BeMo – Jäger Bau)

Project Location:

Wiesing / Jenbach, Tyrol, Austria

Start of Construction: May 29, 2007

Excavation access gallery: July 2007

End of Construction: Feb 28, 2009

Final acceptance and hand-over to the client (exclusive of recultivation) ahead of schedule on December 17, 2008

Project Total Value:

15,609,000 €

Geology:

Wetterstein-limestone

Technical Data:

- Twin-track railway tunnel, 1 tube
  - Tunnel length main tunnel: 671.00 m
  - Cross section: 120 – 145 m²
- Access/evacuation gallery length: 173.00 m
  - Cross section: 50.00 m²
  - Declination: 9.70%
- Turning bay with plant cavern 21.00 m
  - Cross section: 50.00 m²
- Volume excavation: approx. 90,000.00 m³
- Volume concrete inner-lining: approx. 10,000.00 m³
- Excavation by drill and blast method
- Execution by NATM, pressure tight secondary lining with sealing membrane

Other Project-Specific Information:

- Access/evacuation gallery for emergency vehicles.
- Excavation of the main tunnel (west/east) exclusively through the access gallery.
- Enlargement of the main tunnel's ends for TBMs of neighbour lots
- Pressure-tight construction 3 bar

PROJECT DATA SHEET

NEW RAMHOLZ-TUNNEL

Client:

DB Projekt Bau GmbH, DB Netz AG, Deutsche Bahn AG

Contractor:

BeMo Tunnelling GmbH (BeMo)
(formerly: Beton- und Monierbau)

technical sponsor in joint venture

70% in JV „Ramholztunnel" (BeMo – Stutz – Rose)

Project Location:

Rail line 3825 Flieden-Gemünden/Main

Sinntal-Sannerz, Germany

Start of Construction: October 2006

End of Construction: March 2009

Project Total Value:

14,630,000 €

Geology:

Brown-red claystone strata, grenz-quartzite, quartzitic fine sandstone, phylitc rock and plate-sandstone

Technical Data:

- Double-track railway tunnel, single tube
- Total length of tunnel: 1,555.12 ft (474 m)
- Mined section: 1,443.57 ft (440 m)
- Cut & Cover North portal: 55.77 ft (17 m)
- Cut & Cover South portal: 55.77 ft (17 m)
- Pipe roofing South portal: 32.81 ft (10 m)
- Cross-section: 1,334.73 SF (124 m²)
- Open cut: 2,952.76 ft (900 m)
- Excavation by drill and blast, excavation partly under pipe roofing
- Design: shotcrete lining, waterproof reinforced cast-in-situ concrete secondary lining, NATM

Other Project-Specific Information:

- Structural Analysis and Detailed Design (work & as-built drawings) by BeMo's Tunnel Design Dept.
- Crown of the tunnel approximately 22.97 ft – 167.32 ft (7 m – 51 m) below ground surface
- Construction in the vicinity of the existing old tunnel
- Backfilling of old tunnel and open cuts
- Railway track/superstructure construction (new track: 3,592.52 ft (1095 m) thereof 1,555.12 ft (474 m) within the tunnel) and earthworks on rail line under operation

PROJECT DATA SHEET

LOWER FINSTERMUENZTUNNEL

Client:

Landesbaudirektion Innsbruck
Amt der Tiroler Landesregierung
(Office of the Tyrolean Provincial Government)

Contractor:

BeMo Tunnelling GmbH (BeMo)
Technical sponsor in joint venture „UFM“
70% in JV „UFM“ (BeMo - Hilti & Jehle)

Project Location:

Reschenstrasse B180, Nauders, Tyrol, Austria

Start of Construction: Autumn 2006

Start of excavation tunnel: March 2007

End of Construction: 2008

Opened for traffic: October 29, 2008

Project Total Value:

9,400,000 €

Geology:

Buendner slate, lime-mica-slate

Technical Data:

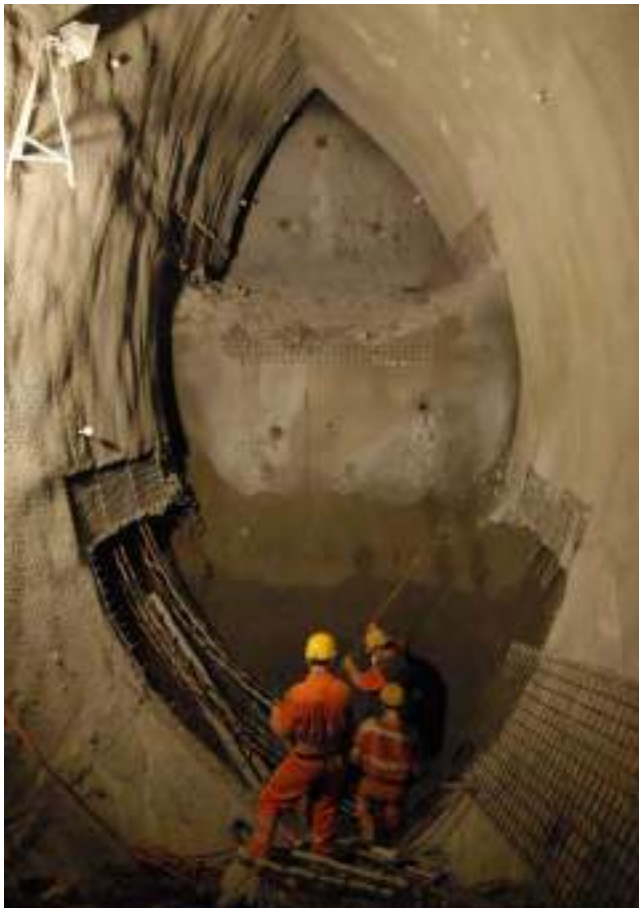
- Double-lane road tunnel, 1 tube
  - Total length of tunnel: 533 m
  - Excavation: 462 m
  - Open cut: 90 m
  - Open cut gallery north: 45 m
  - Open cut gallery south: 27 m
  - Cross-section: 90 m²
  - Geology: Buendner slate, lime-mica-slate
- Execution by drill and blast

Other Project-Specific Information:

- Open cut section by drill and blast
- Driving: drill and blast
- Upgrade of existing road

PROJECT DATA SHEET

LAINZERTUNNEL, LT 31



Client:

ÖBB-Infrastruktur AG, Vienna, Austria
(formerly: ÖBB Infrastruktur Bau AG)

Contractor:

BeMo Tunnelling GmbH (BeMo)
(formerly: Beton- und Monierbau)

Commercial sponsor / partner in joint venture

66.67% in joint venture „LT 31“ (Hochtief – BeMo)

Project Location:

Vienna, Austria

Start of Construction: July 2006

End of Construction: November 2010

Project Total Value:

155,000,000 €

Geology:

Tertiary gravel, sands, coarse clay, silt clay, flysch

Technical Data:

- Double track railway tunnel, 1 tube
  - Tunnel length: 11,958.66 ft (3,645 m)
  - Cross-section: 1,399.31 SF (130 m²)
- 5 escape galleries length (total): 426.51 ft (400 m)
  - Cross-section: 269.10 SF – 322.92 SF (25 – 30 m²)
- 5 escape shafts depth: 4x98.4 ft (30 m), 1x180.5 ft (55 m)
  - Cross-section: 807.29 SF (75 m²)
- Excavation (NATM)
  - 10,006.56 ft (3,050 m) by excavator, sidewall drifts
  - 1,952.10 ft (595 m) by top heading of which 984.25 ft (300 m) by pipe roofing and 967.85 ft (295 m) by mining

Other Project-Specific Information:

- Lowering of groundwater using wells (gravitation- and vacuum-wells)
- Main challenge was tunnelling in close proximity to residential housing and (2 km tunnel) just below Vienna’s existing and operating main railway line
- Overburden approx. 19.69 ft – 85.30 ft (6 m – 26 m) below ground surface (595-m-section: 85.30 ft – 187.01 ft (26 m – 57 m))
- Main tunnel starting from 2 mucking and delivery shafts

PROJECT DATA SHEET

TRÖINGEBERGTUNNEL

Client:

Banverket Västra Banregionen
(Swedish Railway Authority Western Region)

Contractor:

BeMo Tunnelling GmbH (BeMo)
Partner in joint venture
50% in JV (BeMo - Aarsleff)

Project Location:

Heberg, Falkenberg, Sweden

Start of Construction: July 2005

Start of excavation tunnel: September 2005

End of Construction: 2007

Breakthrough tunnel: March 2007

Project Total Value:

Approx. 22,000,000 € (approx. SEK 202,000,000)

Geology:

Gneiss, Amphibolite

Technical Data:

- Double-track railway tunnel, 1 tube
- Tunnel length: 1170 m
- Cross-section: 125 m²
- evacuation tunnel: 150 m
- Cross-section: approx. 25 m²
- Approx. 2350 m open tracks, partly on dam, partly in open cuts
- Drill & blast method, Full face excavation underneath residential area, Comprehensive grouting / no inner lining

Other Project-Specific Information:

- Long project duration can be explained due to the fact that works have to be performed in 2 shift operation only 5 days per week.
- Main challenge: tunnel drive close to residential housing (overburden in the range of 15 – 30 m)
- 2 tunnel portals main tunnel
- 1 tunnel portal evacuation tunnel
- 1 small pedestrian bridge

PROJECT DATA SHEET

TSCHAMBREUTUNNEL

Client:

Landesstrassenbauamt Feldkirch
Amt der Vorarlberger Landesregierung
(Office of the Vorarlberg Provincial Government)

Geology:

Slate-gneiss, amphibolites

Contractor:

BeMo Tunnelling GmbH
partner / commercial co-sponsor in joint venture
50% in JV "Tschambreutunnel" (Jägerbau – BeMo – Züblin)

Project Location:

Silvretta-Bundesstrasse B188, Partenen – Montafon, Vorarlberg, Austria

Start of Construction: September 2005

Projected End of Construction: Autumn 2007

Project Total Value:

10,200,000 €

Technical Data:

- Double-lane road tunnel, 1 tube
  - Tunnel length: 564 m
  - Cross-section: 85 m²
  - Excavation: 460 m
  - Open-cut: 104 m
- Execution by drill and blast
- 48 m soil with pipe roofing (roof pipe umbrella)

PROJECT DATA SHEET

KATSCHBERGTUNNEL, SECOND TUBE

Client: Asfinag Bau Management GmbH	**Geology:** Gneis with fault zones
Contractor: BeMo Tunnelling GmbH (BeMo) Technical / Commercial cponsor in joint venture 60% in JV „Katschbergtunnel“ (BeMo – Jaeger)	**Technical Data:** • Double-lane motorway tunnel • Total length of tunnel: 5418 m • Excavation: 4300 m • Already excavated: 918 m • Cross-section: 88 – 111 m² • Drill and blast method
Project Location: A10 Tauernautobahn, Rennweg, Austria	
Start of Construction: May 2005 **End of Construction:** 2007	**Other Project-Specific Information:** • 14 cross-passages, cross-section: 16 m² • 6 cross-passage for emergency vehicles: 27 – 45 m²
Project Total Value: 48,000,000 €	

PROJECT DATA SHEET

REINSTATEMENT / UPGRADE ARLBERGRAILWAYTUNNEL

Client:

ÖBB Infrastruktur Bau AG, Vienna, Austria

Contractor:

BeMo Tunnelling
(formerly: Beton- und Monierbau)

Co-technical sponsor in joint venture

15% in JV "Arlbergbahntunnel ABT" (Rhomberg – BeMo – Porr – Eiffage-Rail)

Project Location:

Langen am Arlberg, Vorarlberg, Austria

Start of Construction: September 2005

Projected End of Construction: 2010

Project Total Value:

100,000,000 €

Geology:

Gneiss, phyllite, raibler layers

Technical Data:

- Reinstatement and enlargement of an existing double-track railway tunnel under operation
- Total length of tunnels: 10,250.00 m
- 6 Escape tunnels (Cross-passages - CP)
  - each CP incl. 12 m tunnel
- 6 U-turn niches (Cross-passages - CP)
  - each CP incl. 12 m niche
- Cross-section: 53.60 m²
- Access tunnel (cut&cover concrete box): 20 m (6m x 4.2 m)
- Shotcrete sealing - full: 1,600.00 m
- Shotcrete sealing - partial: 3,000.00 m
- Drains: 13,000.00 m²
- Enlargement, invert enlargement
- Ballast-free concrete track slab system („Feste Fahrbahn") including turn-outs

Other Project-Specific Information:

- Provision of logistics, trains for the execution of work with drivers, engines with train drivers and flagmen by the contractor.

PROJECT DATA SHEET

ACHRAINTUNNEL

Client:

Landesstrassenbauamt Feldkirch
Amt der Vorarlberger Landesregierung
(Office of the Vorarlberg Provincial Government)

Contractor:

BeMo Tunnelling GmbH (BeMo)
Parnter / technical sponsor in joint venture
66,66% in joint venture "Achraintunnel (BeMo – Jäger)"

Project Location:

Bregenzerwaldstrasse L200, Dornbirn, Vorarlberg, Austria

Start of Construction: September 2004

Excavation main tunnel: Winter 2004
Equipment: Winter 2007

End of Construction: 2008

Excavation main tunnel: until Summer 2007
Equipment: until 2008

Project Total Value:

55,400,000 €

Geology:

Northern Flysch (geological zone), predominantly in "Weißachschichten" (450 m – 3340 m), a succession of variegated marls containing layers of sandstone, high content of active clay minerals and inherent swelling potential in these layers, clay-marl (0 m – 250 m), sandstone and clay-marl strata (250 m - 450 m)

Technical Data:

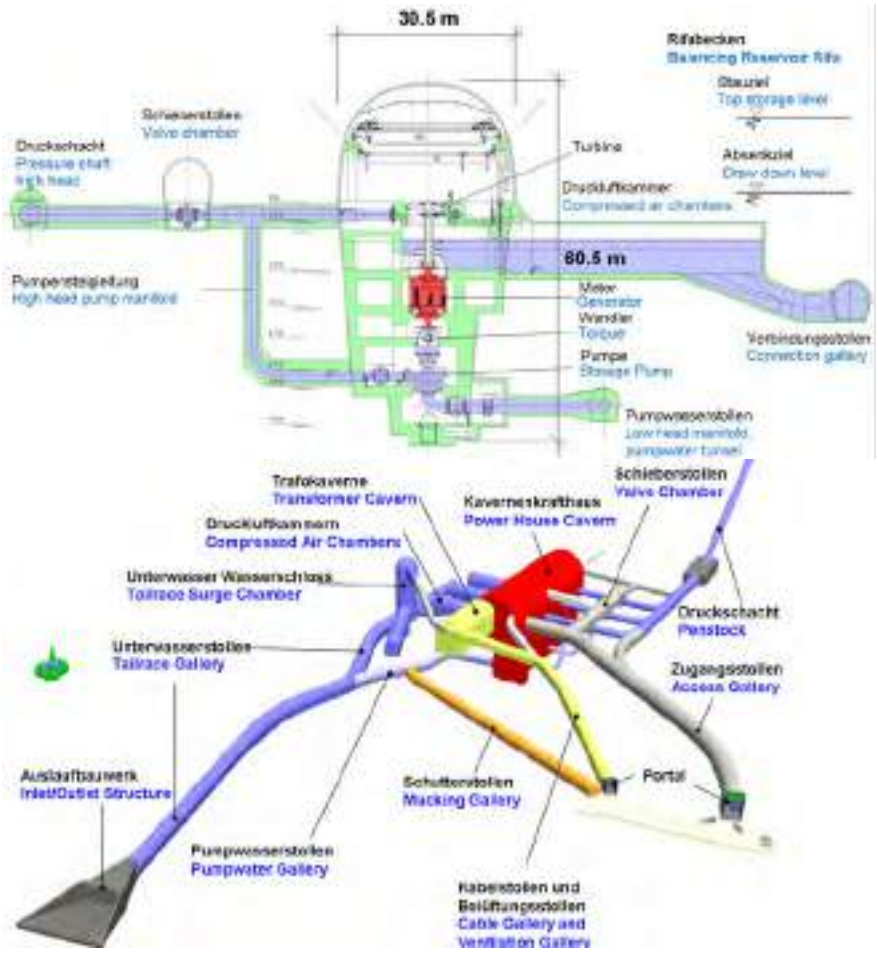
- Triple-lane road-tunnel
- Tunnel length: 3,340 m (gradient: 5.1 %)
- Cross section: 120 – 190 m²
- Excavation by drill and blast and roadheader
- NATM with fast ring closure

Other Project-Specific Information:

- The necessity for a fast closure of the invert by the use of shotcrete, followed by an immediate placement of the final invert arch without longitudinal subdivision, and a subsequent installation of the final lining, led to a bridge solution which allowed the tunnelling works to be continued without unnecessary interruptions
- Bridge used as formwork support for the invert arch and the final lining abutment
- 13 walkable cross-passages to evacuation tunnel
- 1 cross-passage for fire engines and rescue vehicles
- Reinstatement of escape gallery (12 m²)

PROJECT DATA SHEET

450 MW HEP, POWERHOUSE CAVERN KOPS II



Client:

Vorarlberger Illwerke AG

Contractor:

BeMo Tunnelling GmbH (BeMo)
(formerly: Beton- und Monierbau)

Co techn. / technical sponsor in joint venture

"Powerhouse Cavern Kops II"

50% in JV (BeMo – Jäger – Züblin)

Project Location:

Partenen, Montafon, Austria

Start of Construction: September 2004

End of Construction: December 2007

Project Total Value:

50.000.000 €

Technical Data:

- Construction of a underground 450 MW (3 x 150 MW) HEP powerhouse cavern with tailrace structure
- Excavation works:
- Powerhouse cavern: approx. 114,000 m³
  Powerhouse cavern concrete lining works: 48,000 m³
- Transformer cavern: approx. 11,000 m³
- Surge Chamber: approx. 9,000 m³
- 1,782 m various galleries: approx. 78,000 m³
  Cross-section: 2 m² - 100 m², up to 37% in-/declination
- Surge Chamber Shaft: Pilot shaft Alimak raise-climber 35 m, 3 m²,
  Shaft sinking: 30 m, 113 m², Ø 12 m
- 3 Pump rising shafts (each): 25 m, 75° declination
- Selection of galleries, access and service tunnels:
- Access tunnel: 200 m, 58.1 m², 1.1%
- Ventilation/Escape gallery: 210 m, 12 m², 1% - 26%
- Pump water gallery: 180 m, 38.8 m², 17.4%
- Underwater gallery: 250 m, 54 m², 1% - 11%
- Mucking gallery: 200 m, 22 m², 22%
- Execution by drill and blast, Construction by NATM

Geology:

Amphibolite, hornblende gneiss, hornblende schist, talus material, cataclacite

Other Project-Specific Information:

- Tailrace gallery – excavation of 90 m soft-rock section below the Ill river under the protection of a pipe arch (pipe roofing) and 2 groundwater lowering wells
- Spoil removal: excavation material tipping into shaft to crusher chamber, loading crusher, transportation by conveyor belt to landfill area

PROJECT DATA SHEET

HEIDKOPFTUNNEL, LOT 01

Client:

DEGES
(Deutsche Einheit Fernstraßenplanungs- und Bau GmbH)
Zimmerstraße 54, 10117 Berlin, Germany

Contractor:

BeMo Tunnelling GmbH (BeMo)

Technical sponsor in joint venture

80% in JV (BeMo – Stutz – Rohde)

Project Location:

A38 Goettingen – Halle, Reiffenhausen, Germany

Start of Construction: October 2003

End of Construction: December 2006

Project Total Value:

42,600,000 €

Geology:

Sandstone, limestone

Technical Data:

- Double-lane motorway tunnel, 2 tubes
  - Total length tunnels: 3,440 m
  - Tunnel length each: 1,720 m
  - Cross section: 88 – 129 m²
  - Excavation tunnel: 340,000 m³
  - 2 breakdown bays length each: 60 m
  - Cross-section bays: 115 – 129 m²
- Advanced pilot gallery southern tube: 60 m
- Advanced pilot gallery northern tube: 75 m
  - Cross-section pilot galleries: 25 m²
- 5 Cross-passages (2 for emergency vehicles) each 300 m
  - Cross-section Cross-passages: 40 m²
- Excavation open cut: 305,000 m³
- Excavation by drill and blast and NATM excavator with shotcrete support
- Execution by NATM-shotcrete method (wet-shotcrete)
- Secondary lining by waterproof concrete: 46,700 m³

PROJECT DATA SHEET

KIENBERGWANDTUNNEL

Client:

Salzburger Bauträger GmbH (SABAG) on behalf of
Landesbaudirektion Salzburg
Amt der Salzburger Landesregierung
(Office of the Salzburg Provincial Government)

Contractor:

BeMo Tunnelling GmbH
(formerly: Beton- und Monierbau)
Technical Sponsor / Partner in joint venture
70% in JV (BeMo – Jäger)

Project Location:

Kienbergwand Landesstrasse L 217, Schärfling am Mondsee, Salzburg, Austria

Start of Construction: September 2003

Duration Total works: 22 months
Duration Tunnel: 10 months

End of Construction: June 2005

Project Total Value:

13,590,000 €

Geology:

Dolomite, limestone

Technical Data:

- Double-lane road tunnel and bicycle tunnel
- Tunnel length:
  - Road tunnel: 1167 m
  - Mining advance: 1120 m
  - Access tunnels: 1 x 80 m, 1 x 50 m
  - Bicycle tunnel: 847 m
  - Bicycle Cut & Cover: 327 m
- Cross section: 22 – 85 m²
- Excavation by drill and blast/excavator with shotcrete support
- Secondary lining: Cast in place concrete without reinforcement (road tunnel)

Other Project-Specific Information:

- Excavation East with pipe roofing (pipe-umbrella)
- Bicycle cut & cover conrete box construction 327 m

PROJECT DATA SHEET

WEEHAWKEN TUNNEL, BERGENLINE AVE. STATION

Client: New Jersey Transit Corporation	**Geology:** Granite
Main Contractor: Washington Infrastructure Group (formerly: Raytheon Infrastructure) **Contractor:** Beton- und Monierbau USA, Inc. Partner in joint venture 15% in JV „Frontier-Kemper / Shea / Beton- und Monierbau)	**Technical Data:** • Construction of an underground railway-station with vertical-shaft-access • Reinstatement and enlargement of existing track railway tunnel • Total length of tunnel: 1,200 m (3937.01 ft) • Underground station length: 280 m (918.64 ft) • Station Cross-section: 188 m² (2023.62 SF) • Execution by drill & blast, demolition of old brick-lining using tunnel-excavator, shotcrete support, NATM
Project Location: Weehawken, New Jersey, USA	
Start of Construction: 2002 **End of Construction:** February 2006	**Other Project-Specific Information:** • New underground station (shaft, surface ticket hall) • Excavation, securing, re-cabling and expansion of tunnel
Project Total Value: approx. 145,600,000 €	

PROJECT DATA SHEET

SOUTH BOSTON PIERS TRANSITWAY - SILVERLINE, CONTRACT E02CN15

Client:

Massachusetts Bay Transportation Authority (MBTA)

Main Contractor:

Modern Continental Constr., Cambridge, MA, USA

Contractor:

Beton- und Monierbau USA, Inc.
(100% subsidiary of BeMo Tunnelling GmbH)
Partner in joint venture
50% in JV (BeMo USA - Modern Continental)

Project Location:

Russia Wharf Tunnel, Contract No. E02CN15, South Boston Piers Transitway – Silverline, Boston, Massachusetts, USA

Start of Construction: June 2002

End of Construction: 2004

Technical Data:

- Double-lane road tunnel for public transport, 2 “binocular” tubes
- Total length of tunnel: 653.54 ft (199.20 m)
- 2 drives, length each: 326.77 ft (99.60 m)
- Cross-Section “binocular”: 559.72 + 441.32 = 1001.04 SF
  (52.00 + 41.00 = 93.00 m²)
- 413.39 ft (126 m) length of mined section of the curved "binocular" tunnels were mined using NATM in conjunction with ground freezing to stabilize the soil beneath the overlying settlement-sensitive timber foundation support piles of historical buildings in the area of historical Boston Harbour. The crown of the tunnel was only 5.4m (18 ft) beneath the structures basement level.
- Execution by SEM/NATM tunnelling in conjunction with ground freezing in densely populated urban environments, excavators
- Waterproofing: 2 mm PVC membrane

Project Total Value:

12,350,000 € (USD 15,000,000)

Geology:

Artifical fill (bricks, wood, granite blocks, peat), organic clay, marine clay

Other Project-Specific Information:

- Tunnel excavation undercrossing settlement-sensitive historical buildings in area of historical Boston Harbour.
- Overlying timber foundation support piles cut, isolated, reinforced and integrated into the tunnel lining during excavation.
- Ground-freezing above tunnel vault

PROJECT DATA SHEET

KINGS CROSS STATION REDEVELOPMENT

Client:

Metronet Rail SSL Ltd., (London Underground Ltd. - LUL)

Contractor:

BeMo Tunnelling
(formerly: Beton- und Monierbau)
in joint venture with Morgan Sindall (formerly: Morgan=Est)
40% in Morgan BeMo JV (MBJV)

Project Location:

London, UK

Start of Construction: 2002 (ITP, early works)

End of Construction: 2008

Project Total Value:

95,115,000 €

Geology:

London clay

Technical Data:

- Complex Underground Construction (Underground passenger hub, metro tunnels, shafts and passages) connecting existing metro-lines and stations between St. Pancras, Kings Cross Railway and Metro Station. Shotcrete (LaserShell™) used for permanent structures, Spheroidal-Graphite Cast Irons Lining (SGI-Lining)
- Passenger tunnels: 275 m
  - Cross-section: 18.5 m² - 65 m²
- Escalator barrels: 75 m
  - Cross-section: 82 m²
- Methods: Shotcrete Tunnelling, LaserShell™, SGI-Lining

Other Project-Specific Information:

- Partnering Project (NEC-Contract, Option D, Target contract with bill of quantity)
- Challenging conditions due to construction in the vicinity of existing metro-lines under operation
- Overburden 6 m – 25 m

PROJECT DATA SHEET

METRO RHINE-RUHR BOCHUM LOT 306

Client:

Bochum-Gelsenkirchener Stadtbahnverpachtungs-gesellschaft des buergerlichen Rechts

Contractor:

BeMo Tunnelling GmbH
(formerly: Beton- und Monierbau)

technical sponsor in joint venture

75% JV "Tunnel Stadtbahn Bochum Lot 306 (ATSB)"

Project Location:

Bochum, Germany

Start of Construction: October 2001

End of Construction: December 2004

Project Total Value:

26,200,000 €

Geology:

Quaternary sandy silt, Marl

Technical Data:

- Double-/Triple-track metro tunnel with many changes in cross-sections
- Tunnel length:
  - Cut-and-cover tunnel and station: 150 m
  - single track NATM tunnel: 1,060 m
  - double & triple track NATM tunnel: 120 m
- Cross section:
  - single track tunnel: 37 m²
  - double & triple track tunnel: up to 125 m²
- 2 shafts, depths: 22 m and 16 m
- Cross-section emergency escape shaft: 35 m²
- NATM and Excavators, Shotcrete Support
- Pipe roofing (roof pipe umbrella)
- Inner-lining with reinforced waterproof concrete

Other Project-Specific Information:

- Inner-city lot underpassing many buildings
- 2500 m² compensation-grouting of a point-based 3 story underground garage to compensate the settlings
- 20 m underground bridge-building through the carcass of the underground station of lot E1
- Underpassing of a existing and operating metro-line
- Connection with operating metro-tunnels

PROJECT DATA SHEET

AMBERGTUNNEL EAST TUBE

Client:

Landesstrassenbauamt Feldkirch
Amt der Vorarlberger Landesregierung
(Office of the Vorarlberg Provincial Government) on behalf of ASFINAG

Contractor:

BeMo Tunnelling GmbH
(formerly: Beton- und Monierbau)
technical sponsor in joint venture
25% in JV "Ambergtunnel East Tube" (Jäger – BeMo – Strabag – Züblin)

Project Location:

Feldkirch, Vorarlberg, Austria

Start of Construction: May 2001

End of Construction: December 2003

Project Total Value:

29,500,000 €

Geology:

Limestone, Marl

Technical Data:

- Double-lane motorway tunnel, 1 tube
  - Tunnel length: 3,119 m
  - Excavation: 2,967 m
  - Cross section: 70 – 112 m²
- Excavation by drill and blast with shotcrete support
- Secondary lining: Cast in place concrete without reinforcement
- Waterproofing: PVC membrane

Other Project-Specific Information:

- Blasting in urban area
- Shotcrete with steel fiber

PROJECT DATA SHEET

STRENGER TUNNEL, LOT EAST AND WEST

Client:

ASFINAG Bau Management GmbH, Innsbruck, Austria
(former Alpen Strassen AG)

Contractor:

BeMo Tunnelling GmbH (BeMo)
(formerly: Beton- und Monierbau)
commercial and technical sponsor in joint venture
75% in JV "Tunnel Strengen (ATS)" (BeMo – Jäger)P

Project Location:

Arlberg Schnellstrasse S 16, Strengen, Austria

Start of Construction: October 2000

End of Construction: October 2006

North tube provisionally opened early for traffic due to damages to other roads caused by flood: September 2005
North tube opened for traffic: December 16, 2005
South tube opened for traffic: June 2, 2006

Project Total Value:

190,000,000 €

Geology:

Gneiss, Phillitic quartzite, slate-gneiss, clay-slate, quartzite

Technical Data:

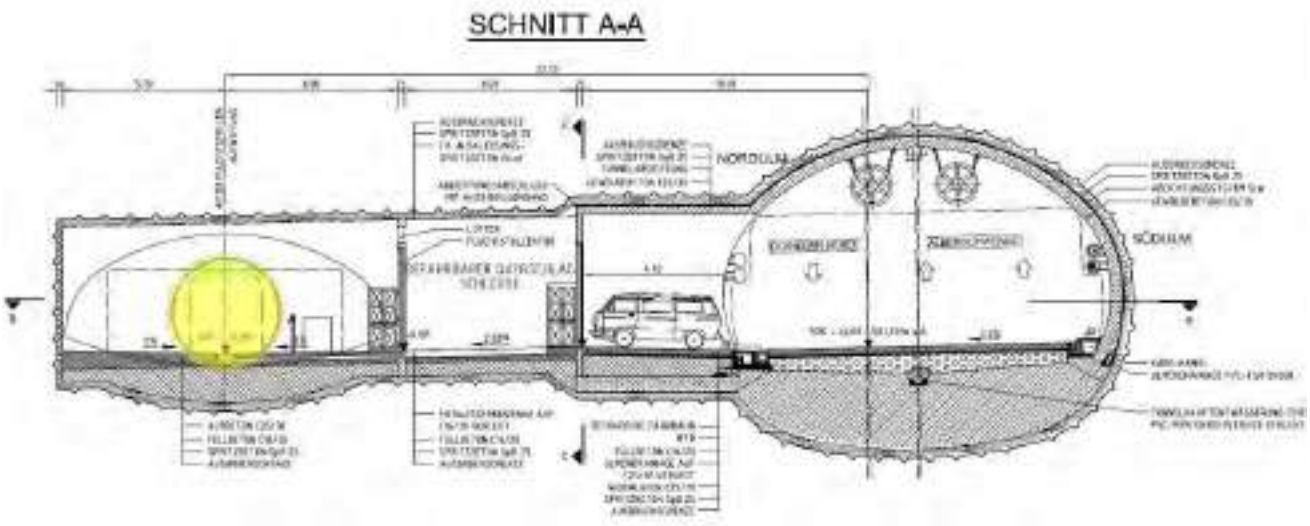
- Double-lane motorway tunnel, 2 tubes
- Total length of Tunnel: 11626m (11399 m of tunnel excavation + Cut & Cover 227 m)
- North + South tube mined section: 5740 m + 5659 m
  North + South tube cut and cover: 111 m + 116 m
  North + South tube total length: 5851 m + 5775 m
- Cross section: 77 – 88 m² (excavated up to 100 m²)
- 6 cross-passages (CP): each. 40 m
  - Cross-section: approx. 16 m²
- 5 CPs for emergency vehicles: each 40 m
  - Cross-section: approx. 27 – 45m²
- Operating reversal bay: 15 m (77 m²)
- Breakdown-bays cross-section: up to 120 m²
- Excavation by drill & blast, excavator with shotcrete support, NATM
- Secondary lining: Cast in place concrete without reinforcement (in fault areas with reinforcement)
- Waterproofing: PVC membrane

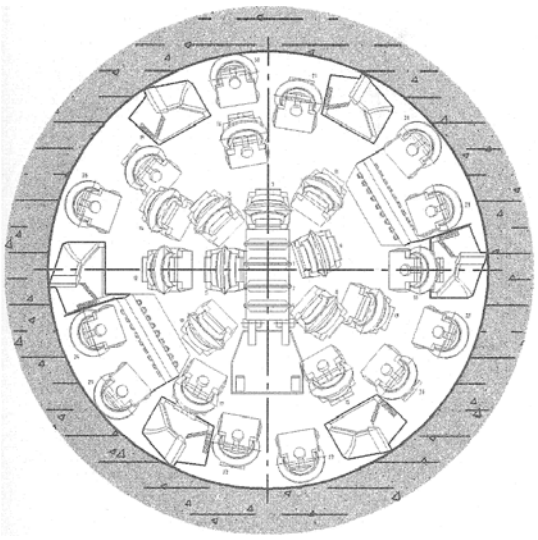
Other Project-Specific Information:

- Settlements up to 60 cm in fault zones
- Earth works: 1.5 Mio. m³

PROJECT DATA SHEET

ACHRAIN EXPLORATORY GALLERY





Client: Landesstrassenbauamt Feldkirch Amt der Vorarlberger Landesregierung (Office of the Vorarlberg Provincial Government)	**Geology:** Sandstone, Marl
Contractor: BeMo Tunnelling GmbH (BeMo) technical sponsor / Ppartner in joint venture 66,67% in JV (Jäger – BeMo)	**Technical Data:** • Exploratory gallery • Tunnel length: 3,165m • Excavation: 2,967m • Cross section: 12 m² • Excavation by TBM drive (diameter 3.9 m) • Support: Steel-Ribs, Rockbolts, Shotcrete
Project Location: Dornbirn, Vorarlberg, Austria	
Start of Construction: November 1999 **End of construction:** April 2001	
Project Total Value: 6,760,000 €	

PROJECT DATA SHEET

NORTH DOWNS TUNNEL / MEDWAY CROSSING (CTRL 410/350)

Client: UNION RAILWAYS Ltd. (Rail Link Engineering)	**Geology:** Chalk
Contractor: BeMo Tunnelling GmbH (BeMo) (formerly: Beton- und Monierbau) Partner in joint venture 33.33% in JV "Eurolink" (BeMo - Morgan - Vinci)	**Technical Data:** • High speed railway tunnel, double-track, 1 tube o Tunnel length: 3,290 m (Excavation 3,206 m) o Cross section: 140 – 160 m² o Excavation by roadheader and excavator with shotcrete support o Secondary lining: Cast in place concrete with reinforced invert and an unreinforced vault o Waterproofing: 2 mm PVC membrane • High speed railway bridge, double-track o Bridge length: 1,261 m o Incremental launched bridge o Constructed using balanced cantilever and incremental launch techniques.
Project Location: Rochester, England, UK	
Start of Construction: October 1998 **End of Construction:** April 2002 August 2001 (tunnel excavation and lining)	
Project Total Value: 200,000,000 € (Tunnel and Bridge)	**Other Project-Specific Information:** • Partnering Project (NEC-Contract, Option C, Target contract with activity schedule) • BeMo also responsible for the design of primary lining of the North Downs Tunnel • Earthworks North Downs Tunnel: 500000 m³ • The Medway Bridge is the most complex prestressed concrete railway bridge in the UK

PROJECT DATA SHEET

BLISADONATUNNEL

Client:

Austrian Federal Railway (ÖBB), Vienna, Austria

Contractor:

BeMo Tunnelling GmbH (BeMo)
(formerly: Beton- und Monierbau)
Commercial Sponsor / Partner in joint venture
50% in JV (Östu-Stettin – BeMo – Swietelsky)

Project Location:

Arlberg Railway, Section Innsbruck – Bludenz, Langen am Arlberg, Vorarlberg, Austria

Start of Construction: October 1998

End of Construction: November 2004

Excavation and interior works: September 2001

Project Total Value:

58,400,000 €

Geology:

Dolomite, marl, arlberg layers, partnach-layers, limestone, soil

Technical Data:

- Double-track railway tunnel
- Tunnel length: 2,920 m
- Double-track tunnel 1,952 m
  - Cross-section: 98 m²
- Single-track tunnel 545 m
  - Cross-section 68 m²
- Access tunnel 423 m
  - Cross-section: 57 m²
- Excavation by drilling & blasting, excavator, NATM

Other Project-Specific Information:

The tunnel consists of a double-track tube, a parallel running single-track tube in the area of the station “Langen am Arlberg” and of a single-track connection tunnel to the existing line

Jet grouting (“Duesenstrahlverfahren DSV”): 6,100.00 m horizontal columns total length, avalanche protection dams for the access tunnel, reconstruction of Langen am Arlberg Railway Station, slope protection, retaining walls, retaining wall of reinforced shotcrete with stone masonry

PROJECT DATA SHEET

NEW HSR-LINE COLOGNE-RHINE/MAIN, TUNNELS LOT A+C

Client:

Deutsche Bahn Projekt GmbH, Deutsche Bahn AG

Contractor:

BeMo Tunnelling GmbH (BeMo)
(formerly: Beton- und Monierbau)
co-technical sponsor in joint venture
19% in JV "ATAC"

Project Location:

New high speed rail line Cologne-Rhine/Main, Germany

Start of Construction: 1996

End of Construction: 2001

Project Total Value:

340,000,000 €

Geology:

Phyllite, Serezit-gneiss, clayey slate, quartzite, mottled slate

Technical Data:

- Double track railway tunnels (1 tube) for DB's new high speed rail line, Section A + C
- Section A: Siegburg – Dierdorf
  - o Tunnel Ammerich: 720 m
  - o Tunnel Fernthal (photos right): 1,555 m
- Section C: Limburg – Mainbruecke
  - o Tunnel Hellenberg: 552 m
  - o Tunnel Schulwald (photos left): 4,500 m
  - o Total length of tunnels: 7,327 m
- Cross-section: 139 – 154 m²
- Execution by backhoe excavation and by drill and blast method, NATM

Other Project-Specific Information:

- Pilot tunnelling 2.5 m²
- Waterpressure on secondary lining 2.5 bar

TUNNELLING
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Know-how Project Data Sheets

Selection of Know-how Transfer Projects

Metro Los Angeles, CA, USA

PROJECT DATA SHEET

QUARTERS TUNNEL, VALLEY LINE LRT, EDMONTON, CANADA

Client:

City of Edmonton, Canada

Geology:

Glacial Till partly permeated with water-bearing sand lenses (up to 1.5 m thick).
Bedrock below Glacial Till with layers of carbon and bentonite.

Main Contractor:

TransEd LRT (Bechtel-EllisDon Construction Joint Venture)

Consultant for SEM/NATM:

BeMo Tunnelling (100% subsidiary of BeMo Tunnelling GmbH):
Supervision, Know-how Transfer, key personnel and plant on site;
1 Senior SEM/NATM Tunnel Manager/Engineer,
2 SEM/NATM Operating Superintendents,
1 SEM/NATM Operators,
1 SEM/NATM Surveyor (instruction of the site crew)

Project Location:

Edmonton, Alberta, Canada

Start of Construction:

February 2016
February 2017 (tunnel drive)

End of Construction:

expected spring 2018

Technical Data:

Know-how Transfer of the New Austrian Tunnelling Method (NATM) for the construction of an inner-city twin-tube tunnel.

The Valley Line (LRT-System = Light Rail Transit) will connect the south-east with the west through downtown Edmonton by a 27 km long line including 25 stops.
The first phase (13.1 km) will include the Quarters Tunnel at the intersection between 102nd Avenue, Jasper Avenue and along the 95th Street:

- Southbound Tunnel Length: approx. 393.00 m
- Northbound Tunnel Length: approx. 402.00 m
- excavation by tunnel excavator SEM/NATM using spile umbrellas
- installation of pipe arch canopies at the tunnel portals

The Transfer of Know-how contains the following services:

- constructability reviews, plant studies and equipment selection
- site set-up, ventilation requirements
- assistance in ventilation issues and various SEM/NATM related issues
- shotcrete mix design

Project Total Value:

1,985,000 € (2,900,000 CAD)

Other Project-Specific Information:

- excavation of a tunnel in urban environment using SEM/NATM and spile umbrellas; shallow overburden (only 3.50 m) at the underpass of the intersection Jasper Ave
- extreme weather conditions (up to -30°C)

PROJECT DATA SHEET

CHINATOWN STATION, CENTRAL SUBWAY PROJECT, SAN FRANCISCO

Client:

City and County of San Francisco Municipal Transportation Agency (SFMTA)

Contractor:

Main Contractor – Contract 1300: Tutor Perrini
Contractor Chinatwon Station: Frontier-Kemper Constructors, Inc.

Consultant for SEM / NATM works: Beton- und Monierbau USA, Inc. (100% subsidiary of BeMo Tunneling GmbH)

Technical support provided by Senior SEM Engineer and SEM Engineer + 2 SEM superintendents on site

Project Location:

San Francisco, CA, USA

Start of Construction: December 2015 (BeMo)

Projected Duration: May 2018 (BeMo)

Project Total Value:

2,500,000 € (2,650,000 US$)

Geology:

Sandstone and weathered sandstone

Technical Data:

Subway station in urban environment;
Part of San Franciscos Central Subway Line;

Mined cavern beneath Washington/ Stockton Street (between Jackson and Clay Street) in San Franciscos most populated area;
Main parts are:

- Cross cut cavern
- Platform caverns
- Crossover cavern
- 2 Emergency exits incl 1 emergency shaft

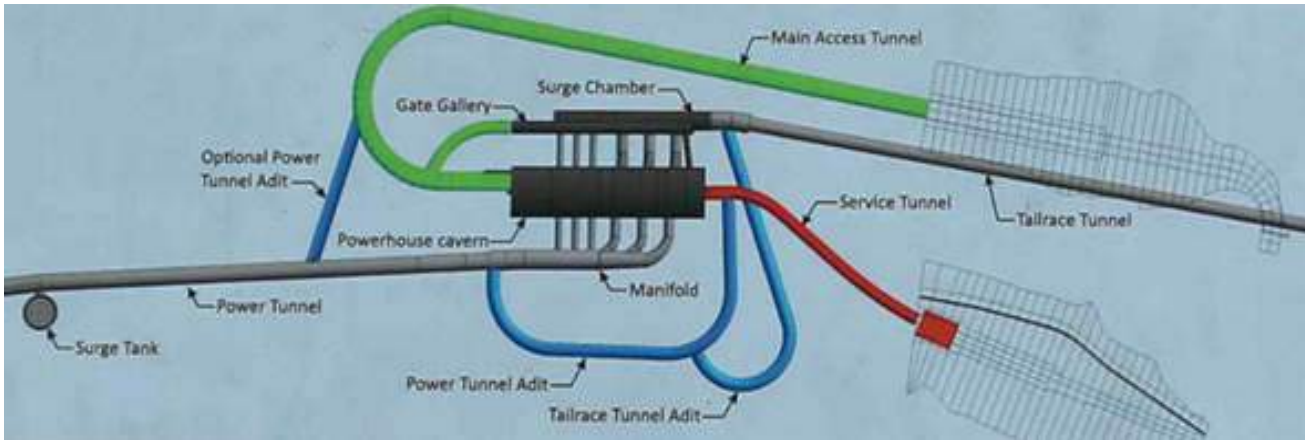
Overall length of the mined cavern: 630 feet;
Overburden between 55 and 85 feet;
Application of sidewall tunnel drift method in combination with continuous presupport with pipe umbrellas (pipe arch canopies)

Execution by tunnel excavator, road header attachment, wet shotcrete, spiling (rebar and grouted pipe spilling), face bolts, dewatering;
tunnel pre-support by pipe roofing

Compensation grouting;

PROJECT DATA SHEET

JOHN HART GENERATING STATION REPLACEMENT



Client:

BC Hydro

Geology:

Sand, cobbles, boulders, wood, hard rock (basalt)

Contractor:

Main Contractor:	Inpower BC
Tunnelling Contractor:	Frontier-Kemper Constructors, Inc.
Consultant for SEM / NATM works:	BeMo Tunnelling Canada Inc.

(100% subsidiary of BeMo Tunnelling GmbH; as consultant for execution of NATM tunneling works in an unexpected soft ground zone; Technical support, Senior NATM Engineer and superintendents on site)

Project Location:

Campbell River, British Columbia, Canada

Start of Construction: July 2015 (BeMo)

End of Construction: May 2016 (BeMo)

Technical Data:

Power Tunnel:	
Total length:	1250 m
Measures:	8.3 m high; 8.1 m wide
Tailrace Tunnel:	
Total length:	400 m
Measures:	10.7 m high; 6.5 m wide
Main Access Tunnel:	
Total excavation:	300,000 m³
Measures:	7.5 m high; 9.5 m wide
BeM;o's work zone:	60 m long soft ground zone consisting of weak rock and sand

After surprisingly entering a soft ground zone (sand, gravel, cobbles) excavation applying SEM / NATM using pipe arch canopies, spiling, face bolts, grouted face bolts, elephants feet in combination with shotcrete (dry/wet) as tunnel pre support.

Project Total Value:

1,018,000 € (1,493,000 CAD)

Other Project-Specific Information:

Extreme mixed face conditions with loose sand required intense application of pipe roofing in double layers including ground improvement by using grouting via endcaps and via double packers with microfine cement. Dewatering measures by applying gravitational methods and vacuum dewatering.

PROJECT DATA SHEET

NEW YORK EAST SIDE ACCESS – CONTRACT CQ031




Client:

Metropolitan Transit Authority MTA

Main Contractor:

Granite - Traylor - Frontier JV

Consultant for 3-cell NATM crosspassage:

BeMo USA: Essential design-input for 3-cell NATM crosspassage between Yard Lead Tunnel and Emergency shaft structure; Consulting and Technical Support during execution; Know-how transfer; two SEM/ NATM Tunnel Superintendents for round the clock coverage on site

Project Location:

Long Island City, Queens, NY, USA

Start of Construction: June 2012

End of Construction: December 2012

Project Total Value:

approx. 500,000 € (650,000 USD)

Geology:

Jet grouted soil

Technical Data:

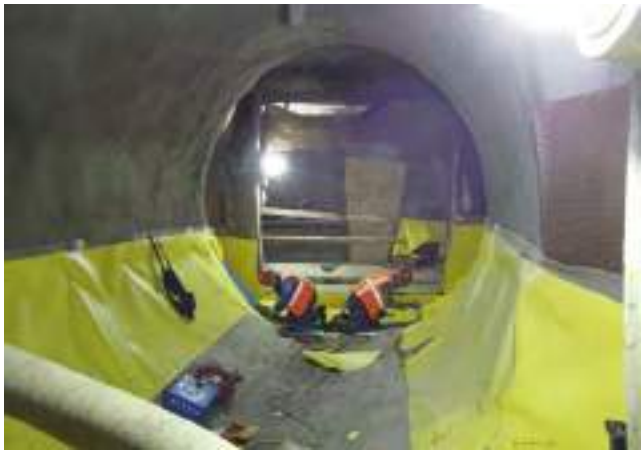
- Essential design input for design of 3-cell crosspassage
- Know-How-Transfer Project (application of SEM / NATM) for the construction of a 3-cell crosspassage between the segmentally lined Yard Lead Tunnel and a vertical concrete emergency shaft
- 3 tunnel excavation phases (each apx. 16.4ft (5 m) in length)
- 3 waterproofing / concrete phases
- Cross sections: apx. 42m²/ 28m²/ 28m² (452.08SF / 301.39SF / 301.39SF)
- Excavation by mini excavator (Brokk) under spile umbrella and in jet grouted soil
- Installation of steel frame “hamster cages” in main tunnel

Other Project-Specific Information:

- Emergency shaft located in Amtrak area

PROJECT DATA SHEET

SEATTLE UNIVERSITY LINK LIGHT RAIL – CONTRACT U220



Client:

Sound Transit, Regional Transit Authority, Seattle, WA, USA

Main Contractor:

Traylor Frontier JV

Consultant for NATM/ SEM:

BeMo USA as consultant for execution of NATM crosspassages between two segmentally lined TBM tubes; Technical Support, Know-how transfer; Senior NATM Tunnel Engineer on site

Project Location:

Seattle, WA, USA

Start of Construction: November 2011

End of Construction: October 2012

Project Total Value:

approx. 315,000 € (410,000 USD)

Geology:

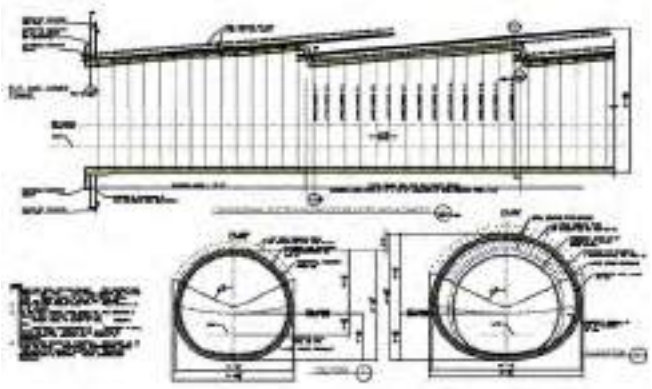
Over-consolidated sand/clay, at some crosspassage locations more than 60 m overburden (ground water pressure 6 bar), partly additional measures necessary (spiling, vacuum dewatering, ground water lowering by means of surface wells, potentially gassy conditions)

Technical Data:

- 2 TBM tubes — inner Ø 18.83 ft (5.74 m); length 2 x 9,842.52 (2x 3,000 m)
- Excavation and support of 16 NATM crosspassages
- Cross sections ca. 20 – 30 m² (215.28 SF – 322.92 SF)
- Deep sump in one of the crosspassages
- Execution by mini excavator (Brokk, CAT) and attachment tools (shovels, road header, chisel); partly manual excavation
- Excavation of some crosspassages concurrent with TBM excavation
- Installation of shotcrete propping system in main tunnels
- All crosspassages located underground water table
- Waterproofing
- Secondary lining (cast in situ / cast-in-place (CIP) concrete)

PROJECT DATA SHEET

NATM TUNNEL TYSONS CORNER, DULLES CORR. (DCMP)



Client: Metropolitan Washington Airport Authority (MWAA)	**Geology:** Costal plane and Piedmont sediments under shallow overburden
Main Contractor: Dulles Transit Partners LLC., Vienna, VA, USA **Contractor:** Beton- und Monierbau USA, Inc. (100% subsidiary of BeMo Tunnelling GmbH, Austria) specialised support for NATM soft ground tunnelling	**Technical Data:** • Twin tube Metro tunnel (as part of an 11 miles Metro extension towards Dulles airport) • Total length of tunnel: 2 x 1600 ft (2 x 500 m) • Shallow overburden: 10 to 40 ft (3 to 12 m) only, with a main traffic ro • Cross-Section (min): 390 SF (36.2 m²) • This could be done only by applying a forepoling support (steel pipes for the canopy – pipe arch canopy), which created a specific sawtooth shape to the initial liner. The length of the pipes was 18 m and the sawtooth had 12 m. • The general excavation and support sequence followed the principles of SEM/NATM • The sawtooth was filled partially with shotcrete • Waterproofing: 2 mm PVC membrane • 40 blocks of the final liner were reinforced.
Project Location: Dulles Corridor Metrorail Project (DCMP), Tyson Corner, Virginia, USA	
Start of Construction: April 2009 **End of Construction:** December 2011	
Project Total Value: 4,500,000 € (USD 6,100,000)	**Other Project-Specific Information:** • Tunnel excavation undercrossing roads, utilities and hotels close by. • Water-table approx. beyond springline. • Intensive ground monitoring.

PROJECT DATA SHEET

EMERGENCY STORAGE PROJECT, SAN VICENTE PIPELINE

Client:

San Diego County Water Authority (SCDWA), California, USA

Main Contractor:

Traylor / Shea JV

Consultant for NATM (Reach 5):

Beton- und Monierbau USA, Inc. as Consultant for Reach 5 (East and West): Design, Technical Support, Supervision, Know-how Transfer, Senior SEM/NATM Tunnel Engineer and SEM/NATM Tunnel Specialist Operator on site

Project Location:

San Diego, California, USA

Start of Construction: January 2006

End of Construction: September 2006

Project Total Value:

approx. 500,000 €

Geology:

Conglomerate below the water table, highly weathered granitic rock and hard granitic rock

Technical Data:

- Know-how Transfer for Reach 5 (East and West)
- Total length of the project: 17,454.00 m
- Diameter excavated: 3.50 m – 4.00 m
- Execution by hard and soft rock TBM, drill and blast, excavator in soft ground, back
- Reach 5 (5 East and West)
  - Total length of tunnel: 1,585.00 m
  - Execution by drill and blast 1,219.00 m
  - Execution by excavator 366.00 m
  - Diameter excavated (5E): 3.60 m
  - Diameter excavated (5W): 4.00 m

PROJECT DATA SHEET

BEACON HILL STATION PROJECT, C170






Client:

Sound Transit, Central Puget Sound, Regional Transit Authority, Seattle, WA, USA

Main Contractor:

Obayashi Corp.

Consultant for SEM/NATM:

BeMo USA as Consultant for SEM/NATM: Supervision, Know-how Transfer, SEM/NATM Tunnel Project Manager, SEM/NATM Tunnel Project Engineer and 3 SEM/NATM Tunnel Superintendents on site

Project Location:

Seattle, Washington, USA

Start of Construction: June 2005 (SEM/NATM)

End of Construction: April 2008 (X-passages SEM/NATM)

Project Total Value:

approx. 3,000,000 €

Geology:

Highly variable glacial deposits including water bearing sands and silts approx. 50 ft below multiple perched water tables in an urban setting (very unique and challenging)

Technical Data:

- Know-how Transfer of the Sequential Excavation Method (SEM) / New Austrian Tunnelling Method (NATM) for the construction of an underground station
- Main shaft with headhouse:
  55 m (181 ft) deep x 15.8 m (52 ft) diameter
- Ancillary ventilation shaft with headhouse:
  50.5 m (164 ft) deep x 9.3 m (30.5 ft) internal diameter
- Two platforms (north and south): 116.7 m (383 ft) long.
- Two councourse cross-adits: 19.5 m (64 ft) long
- Tunnels excavated by SEM/NATM, excavator in soft ground with shotcrete lining and excavation in multiple drift sequences (ground conditioning and pre-support where needed). Final lining by cast-in-situ steel fiber-reinforced concrete, with conventional bar reinforcement at junctions.

Other Project-Specific Information:

This deep "binocular" station is being mined through some of the most challenging soft ground conditions in the USA. The excavated volume of the station is approximately 60,000 cy (46,000 m³) and the station comprises a variety of geometries and cross sections ranging from 235 SF (22 m²) up to 1,670 SF (155 m²). This underground complex includes platform, concourse, cross-passage and emergency ventilation tunnels together with station egress and ventilation shafts. Various excavation sequences are in use for the different tunnels including the twin-sidewall drifts for the impressive 45 ft (13.7 m) wide by 42 ft (12.8 m) high concourse cross adits. This station has two train platforms approx. 165 ft (50m) below the surface.

PROJECT DATA SHEET

LOS ANGELES METRO GOLD LINE EASTSIDE EXTENSION

Client:

Los Angeles County Metropolitan Transportation Authority, Los Angeles, California, USA

Main Contractor:

Traylor Frontier Kemper JV

Consultant for NATM-Crosspassages:

BeMo USA as Consultant for NATM-Cross-passages: Design-input for NATM-Crosspassages between TBM-Metro-Tunnels, Consulting and Technical support, Know-how Transfer, SEM/NATM Tunnel Engineer and SEM/NATM Tunnel Specialist Operators on site

Project Location:

Los Angeles, California, USA

Start of Construction: 2005

On-site support: 09/2006 – 04/2007

End of Construction: 2007

Project Total Value:

approx. 474,000 € (610,000 USD)

Geology:

Alluvium, non-homogeneous sediment layers, medium dense clays to loose silts and sands, layer thicknesses 1-20 ft (0.3 - 6.1 m), methane gas, hydrogen, sulfide and methanol, up to 1.5 bar of hydrostatic pressure

Technical Data:

- Know-how-Transfer Project of the New Austrian Tunnelling Method (NATM) for the construction of NATM-Crosspassages between segmentally lined twin tunnels
- 6 Crosspassages: each approx 36 – 38 ft (11 – 12 m)
- Cross-section: 242.63 – 283.48 SF (22.54 – 26.34 m²)
- Excavation by excavator under pipe arch (pipe roofing), installation of "hamster cages" in both tunnels
- Execution by SEM/NATM

Other Project-Specific Information:

- Excavation 49.21 ft (15 m) below ground level
- Sequential excavation in 3 – 9 ft (0.91 – 2.74 m) increments, top-heading, bottom-bench under pipe arch (pipe roofing), installation of "hamster cages" in both tunnels
- Most crosspassages are located under the water table, and up to 1.5 bar of hydrostatic pressure

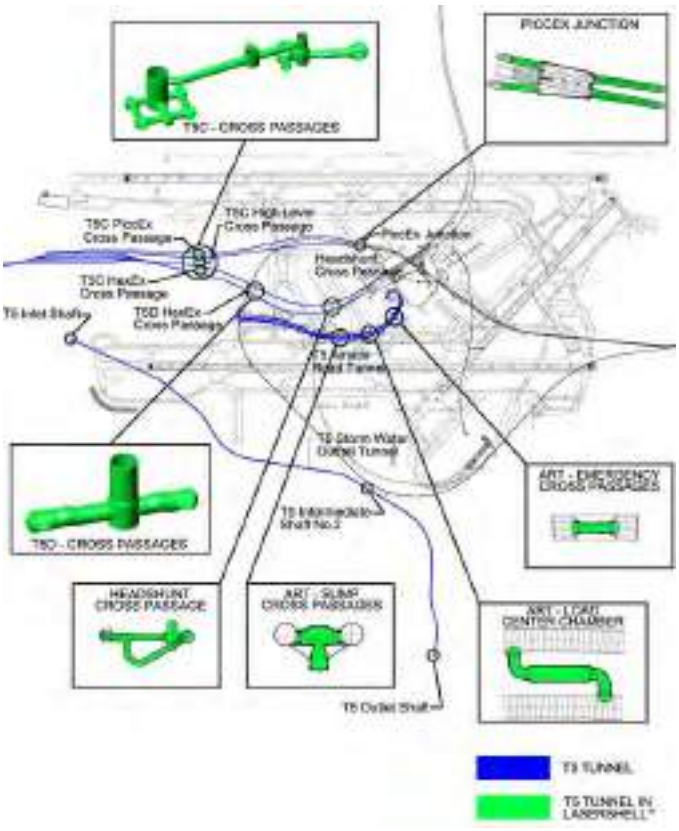
PROJECT DATA SHEET

METRO PUENTE ALTO

Client: Metro Santiago	**Geology:** Conglomerate
Main Contractor Consorcio V.E.I. **Consultant for NATM:** BeMo Tunnelling as consultant for NATM: design, technical support, know-how transfer	**Technical Data:** • Know-how Transfer of the New Austrian Tunnelling Method (NATM) for the construction of an underground station and a double track metro tube • Station tube: 120 m • Cross section: 160 m² • Double track metro tube: approx. 1,500 m • Metro cross section: 80 m² • Preparation of technical special proposals • NATM-Specialists provided • Excavation by excavators - Lot completely in permanent shotcrete
Project Location: Santiago de Chile, Puente Alto, Chile	
Start of Construction: 2003 **End of Construction:** 2004	
Project Total Value: Approx. 500,000 €	

PROJECT DATA SHEET

HEATHROW TERMINAL 5 (T5) / AIRSIDE ROAD TUNNELS



Client: British Airports Authority (BAA)	**Geology:** London clay
Main Contractor: Morgan / Vinci JV **Consultant for NATM:** BeMo Tunnelling GmbH as Consultant: Design (Structural analysis and detailed design), LaserShell™ and TunnelBeamer™ development, Technical Support, Supervision, Know-how Transfer, NATM Tunnel Engineers and NATM Surveyor on site	**Technical Data:** • Know-how Transfer project of the New Austrian Tunnelling Method (NATM) with Morgan Vinci JV for the construction of complex underground- and tunnel-systems for TBM-crosspassages, ventilation shaft, access tunnels, startershafts and –caverns: • 12 shafts and 30 underground- and tunnel-structures constructed using LaserShell™ shotcrete method for Heathrow Express Extension (HexEx) and Piccadilly Line Extension (PiccEx) • Total length shotcrete works tunnels: 880 m • T5 cross section: 15 – 130 m² • ART cross section: 10 – 35 m² • Total depth of shotcrete works shafts: 249 m • Depth of shafts: 14 m – 35 m • Diameter shafts: 3.7 m – 13.8 m
Project Location: London, UK	
Start of Construction: 2002 **End of Construction:** 2006	
Project Total Value: 5,580,000 €	**Other Project-Specific Information:** • Shotcrete works in LaserShell™

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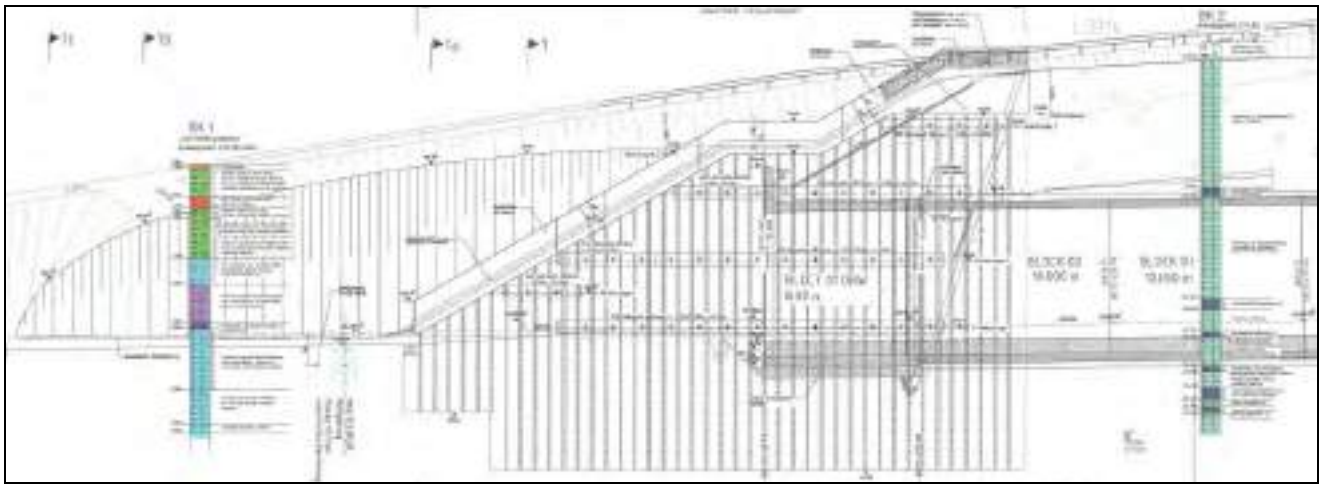
Ground Engineering Project Data Sheets

Selection of Ground Engineering Projects

BIMSB, Berlin, Germany

PROJECT DATA SHEET

TUNNEL ZIERENBERG



Client:

DB RegioNetz
Infrastruktur GmbH
Kurhessenbahn
Rainer-Dierichsen-Platz 1
34117 Kassel

Planning:

DB ProjektBau GmbH
Regionalbereich Mitte
Hahnstraße 52
60528 Frankfurt/Main

Special Planning:

Planungsgemeinschaft Schüssler Plan
Amberg Engineering Lindleystraße 11
60314 Frankfurt / Main

Description:

The projected block wall lies on a hillside cross to the tunnel axis. The notch is about 16m high while the hill has a slope of 40°.

Hillside the notch gets anchored with a drilled pile wand. The planned tunnel will run about 0,5m in front of the pile wand.

Geology:

The top 5m of the hill consist mainly of rubble and loam. Below there's a 1,5m thick layer of weathered or heavily weathered rock.

Contractor:

BeMo Tunnelling GmbH (BeMo) – Department Special Foundation Construction

Project Location:

Volkmarsen – Obervollmar
Section from km 25,390 to km 26,980

Start of Construction: June 2015

Projected Duration: November 2015

Project Total Value:

1.260.728 €

Technical Data:

- Drilled Pile Wand:
  - 122m drilling template
  - 1.474m² block wall ø90cm
  - 137 to drilled pile wand
  - restoration of the top drilled pile wand
- Grouted Anchors:
  - 5000m grouted anchors: drilling and grouting
  - tension tests on the anchors

PROJECT DATA SHEET

BIMSB – BERLIN INSTITUTE FOR MEDICAL SYSTEMS BIOLOGY

Client:

MDC Max-Delbrück-Centrum für Molekulare Medizien – Berlin

Contractor:

BeMo Tunnelling GmbH (BeMo) – Abteilung Spezialtiefbau

Project Location:

Campus North, Humbold-University in Berlin, Germany

Start of Construction: March 2015

Projected Duration: September 2015

Project Total Value:

2.150.000 €

Geology:

0,2 m below surface

Mounting and sealing (asphalt, concrete)

2,4 m below surface

Fillings of fine sand material (sand, clay)

Decomposed with leftovers of concrete and bricks

Isolated fillings of humid sands

12,7m below surface

Typical „Warschau-Berlin Urstromtal"-sand

Composition varies between sands and middlesands with light parts of gravel and clay

Technical Data:

- Excavation
  - Trenches and excavation with disposal
- Slurry wall
  - Planning
  - Continuous inclinometeremeasurement
  - 230m guide walls
  - 2370 m² slurry wall
  - 127 to. Concrete steel
- Grout injection
  - 145 Stück/1.585m anchors
- Jet grouting
  - Planning
  - 2020m² jet grouting sole
  - Quality control with pumps
  - Water drainage
- Exchange drilling
  - Replacement of contaminated ground (due to mineral oil carbon)

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