Worldwide Activities

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Dr. SAUER & PARTNERS

TUNNEL DESIGN

GEOTECHNICAL ENGINEERING

CONSTRUCTION MANAGEMENT

INSTRUMENTATION & MONITORING

WATERPROOFING & WATER CONTROL

TUNNEL REHABILITATION

MINING SUPPORT SERVICES

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Dr. SAUER & PARTNERS

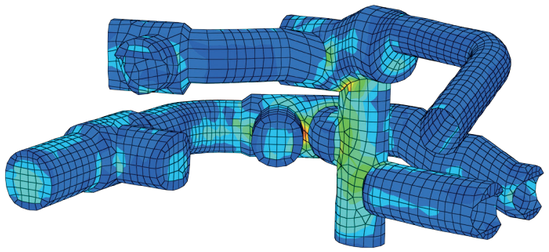
Mining Support Services

Access tunnels, shafts, ventilation adits, mucking routes, underground welfare facilities, and other mine support structures are often constructed through difficult ground conditions. Dr. Sauer & Partners provides state-of-the art design solutions and on-site construction support services for the global mining industry based on its vast tunnelling and shaft sinking know-how.

The New Austrian Tunnelling Method (NATM) is a cost-effective and safe tunnelling method developed for difficult ground conditions. It allows tunnels and shafts necessary for mine development to be built quickly and durably to sustain mining operations over many years. Dr. Sauer & Partners has a proven record of delivering NATM tunnelling and mining projects around the world.
We specialise in the design of complex underground structures and have comprehensive know-how and understanding of:

- ground conditions, from soft soils to hard rock, including squeezing or swelling ground;
- ground behaviour, which, based on soil strata or rock jointing, determines excavation and support techniques;
- modelling complex three-dimensional geometries in heterogeneous ground conditions;
- designing efficient, durable linings;
- construction safety, processes, methods, and site logistics; and
- material and equipment choices, their strengths and limitations.

SPRAYED CONCRETE
for ground support V



^ FINITE ELEMENT MODEL

BENEFITS OF NATM FOR MINING PROJECTS

NATM is one of the most adaptable and responsive tunnelling excavation and support methods available and is used worldwide. The NATM approach allows a high degree of flexibility during construction and makes it possible to control virtually all kinds of ground conditions. An exposed excavation area allows adaptability to unforeseen changes in geological and hydrological conditions. Further benefits include flexible response to cross-sectional changes and the rapid mobilisation of excavation equipment.

DIFFICULT GROUND CONDITIONS

Ground improvement techniques are utilised when a mine or a mining support structure needs to be constructed in adverse ground conditions that make safe excavation and lining installation impossible. These techniques, such as ground freezing, dewatering, permeation, and jet grouting, have a successful history in civil engineering tunnelling projects. They can be applied from the surface, from a dedicated shaft or grouting gallery, or from within the tunnel advance itself.

Dr. Sauer & Partners' Services

Dr. Sauer & Partners' NATM design and field personnel employ vast knowledge and experience in safely and efficiently managing the design and construction of tunnels or shafts. We offer the following:

- **TECHNICAL STUDIES**
  Feasibility, comparative, and other technical studies
- **DESIGN**
  Conceptual, preliminary, and final designs
- **TRAINING**
  Guidance of contractor and client staff in NATM principles and management prior to and during construction to decrease construction time and to increase safety
- **MATERIAL AND EQUIPMENT ADVICE**
  Know-how of tunnel support elements, such as sprayed concrete, lattice girders, and spiles. Advise on material orders, material quality and material quality control/assurance processes. Knowledge of equipment choice, utilisation, operation, maintenance, and training of operators. This will help lower the cost of labour, equipment, and material by more efficient utilisation
- **GEOTECHNICAL EVALUATION**
  Inspection and approval of ground treatment and dewatering works prior to NATM tunnelling, evaluation of ground conditions at the tunnel face, determination of the required ground support class in coordination with the contractor, and inspection of the initial shotcrete lining installation and other support elements
- **MONITORING**
  Provision of monitoring and survey know-how; supervision of the installation of geotechnical instrumentation, interpretation of the monitoring data, and implementation of adjustments to the excavation and initial support procedures
- **DOCUMENTATION**
  Record keeping of the progress, personnel, equipment, and geologic conditions during each phase of the tunnelling works; tracking and analyses of contractor performance to improve work efficiency, in part by reducing downtime; and maintenance of comprehensive documentation thereof

< CIGAR LAKE MINE
Saskatchewan, CAN

The **CIGAR LAKE MINE** boasts the world's second-largest high-grade uranium deposit and is considered one of the world's most technically challenging uranium deposits to mine. It features a flat-lying ore body with highly altered ground above and below and 450 meters of water head. The ore body and surrounding ground has to be bulk frozen prior to extracting the ore with high-pressure water jets.
Working with the mine owner and the client, Dr. Sauer & Partners implemented an innovative solution using NATM principles to address extremely difficult geology and the squeezing ground conditions. The solution included a flexible shotcrete lining using compressible elements and rock bolt support to tunnel through this area.
Dr. Sauer & Partners provided technical oversight and consultancy services for NATM tunnelling works at the mine. This work included the rehabilitation of existing and the construction of new production and freeze tunnels in heavily altered and highly anisotropic ground conditions below the ore body using flexible lining. The presence of our knowledgeable and experienced site support staff ensured success for the mine's owner and our client.

Client: Alan Auld, **Owner:** Cameco