



Geotechnical Engineering and Dams

Solving Geotechnical Challenges for Hydropower and Water Resources Projects

Geological and geotechnical challenges are often very demanding when planning hydraulic structures. Hydropower, water supply and irrigation projects require detailed geotechnical investigations before the start of the actual design works. During planning and execution of the works, ongoing input by geotechnical specialists is essential. The adopted design inevitably depends on the specific project requirements and actual in-situ conditions.

The focus of Lahmeyer International in the field of geotechnics is: design, supervision and monitoring during construction of all kinds of rock and soil structures, such as: caverns, tunnels, slopes, dykes and dams. This includes the evaluation of the optimum location and orientation of the structures by designing individually tailored geotechnical investigation programmes. The scope of works covers all investigation and testing that is necessary to determine the required geotechnical parameters for underground structures, dams, foundations, etc. as well as for obtaining construction materials such as natural fill or aggregate materials.

Lahmeyer International's substantial experience over many years guarantees that the geotechnical work for all phases in the fields of investigation, review, planning, tendering, construction supervision and commissioning can be supplied from one source using experienced specialists. Our specialists can run their own projects, or prepare expert reports, or can be integrated within design or construction teams.

Being up to date in the field of geotechnics also requires utilisation



Rock excavation for intake structure

of a wide range of computer software. These run largely under the latest easy to use operating systems.

The geotechnical staff of Lahmeyer International stays in close

contact with suppliers and developers of proprietary software products in order to secure further developments and updates of the software packages.



Concrete works in powerhouse cavern

Geology

Geological Investigations

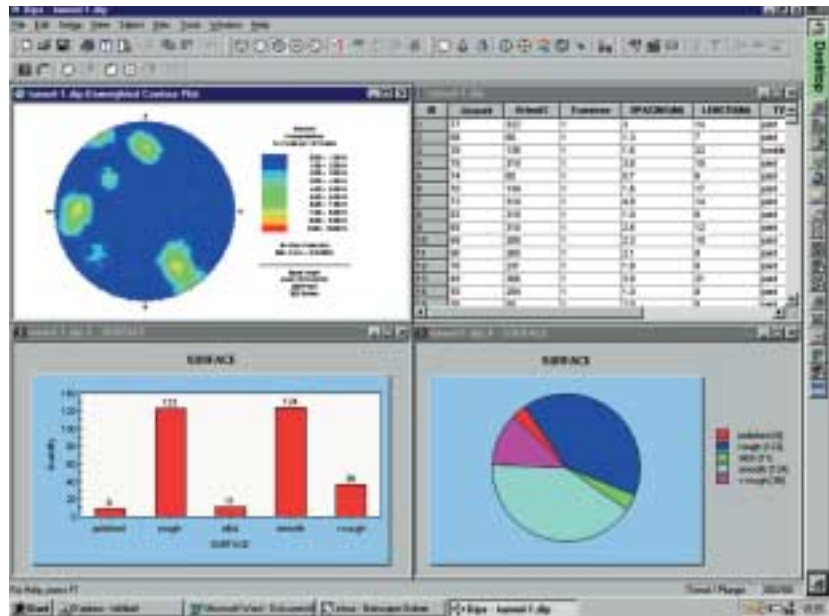
- Establishing geological basics from regional and detailed mappings, aerial photo interpretation, survey of stratigraphy, lithology, petrography, discontinuity systems and tectonics of the site.
- Borehole and surface geophysics for a continuous survey of the site characteristics in collaboration with specialised firms.
- Evaluation of seismic activity and estimation of seismic risk.
- Identification of material sources and testing of their suitability as dam fill materials or concrete aggregates.

Engineering and Hydro Geology

- Design and tendering of geotechnical investigation programs. Execution, supervision and evaluation of in-situ and laboratory testing of all kinds, often in cooperation with specialised companies.
- Rockmass and soil classification, estimation of excavation and support classes. Determination of geotechnical parameters as basis for static and dynamic analyses.
- Judgement of ground water conditions and their influence on structures. Design of ground water barriers such as cut-off walls and grout curtains.



Set up for direct shear test



Graphical and statistical analysis of orientation data



Foundation excavation for concrete gravity dam



Break through of TBM

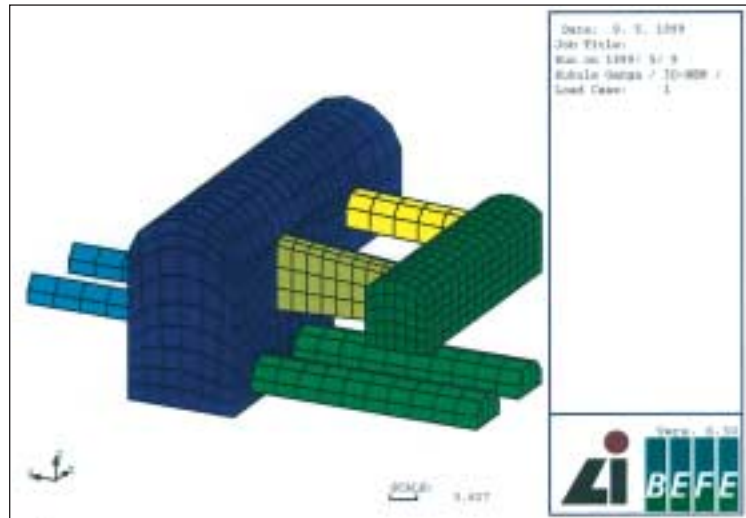
Underground and Rock Engineering

Design and Analyses of Structures in Rock

- Design, analyses and support evaluation for all stages for slopes, tunnels, caverns, shafts, etc.
- Determination of excavation sequences and techniques, blasting methods, handling of water, specialised construction methods and support measures.

Monitoring

- Design of instrumentation systems and monitoring programs. Evaluation and interpretation of monitoring data during project construction and operation.
- Vibration measurements to check blast vibrations.
- Geological and geotechnical mapping during construction and 'as-build' documentation after construction.
- Back analyses of structures and comparison of measured against predicted monitoring data. Adaptation of support measures according to encountered conditions and monitored behaviour if so required.



3D model for underground openings



Result plot of 2D finite element analysis for excavations



Excavated powerhouse cavern

Dam Engineering

Design of Dams

- Selection of dam sites and best suited dam type. All design stages for dams and appurtenant structures.
- Analyses of dams e.g. by slip circle, 2D and 3D FEM, thermal, consolidation and seepage analyses.
- Design of construction pits, including determination of support type, grouting/sealing, ground water lowering and water handling measures.
- Investigations, design and supervision for construction of impermeable barriers and drainage systems in dams and their foundations and abutments.

Special Topics

Environmental Investigations

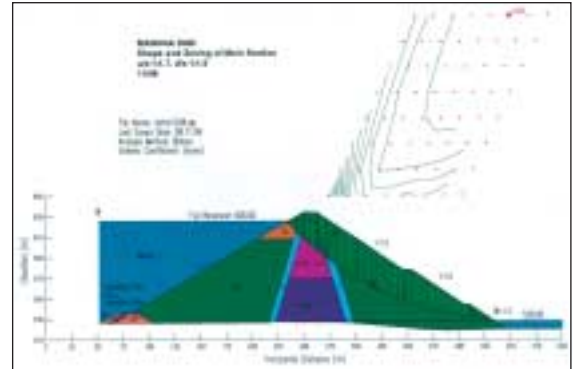
- Determination of environmental influences of dams and reservoirs.
- Geotechnical input to environmental impact studies.

Consultancy to Contractors and Financiers

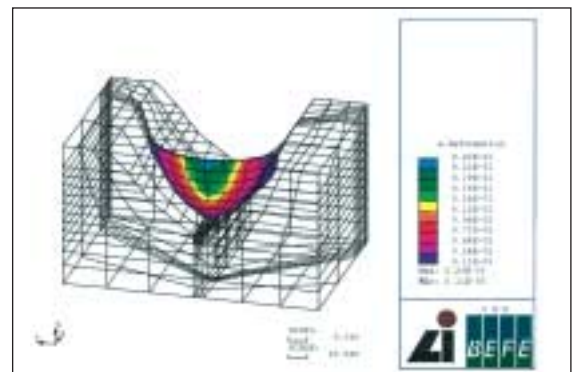
- Preparation of expert reports, risk evaluation, cost estimates, support to project management. Advice on all geotechnical aspects of the works, including technical aspects of claims.
- Support for preparation of proposals and detailed construction design.

Monitoring

- Design of dam instrumentation. Evaluation of deformations, stresses, water pressures, temperatures, seismological and geodetic data and comparison of measured and predicted monitoring data during construction and operation.
- Back analyses of deformation, strength, permeability and other dam and foundation parameters using monitoring data and re-evaluation of the dam stability.
- Design of operation and maintenance manuals.
- Preparation of yearly dam reports, safety analyses and reports.



Slip circle analysis of rockfill dam



3D finite element analysis of arch dam

- Construction supervision.
- Damage and loss analysis.
- Due diligence consultancy.

Rehabilitation

- Recording existing conditions, damage assessment, development of rehabilitation concepts, design and supervision of rehabilitation works for existing dams and appurtenant structures.



Double curved arch dam



Construction of asphalt core in rockfill dam



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