Innovative and client-oriented solutions for geotechnical and hydrogeological projects
Solexperts AG rests on a firm foundation with over 30 years experience of highly qualified personnel providing support in geotechnical and hydrogeological projects with proven measurement concepts, globally-recognised measuring systems and techniques, instrumentation, monitoring and field testing methods.

The team consists of an inter-disciplinary group of specialist engineers and geologists in the fields of geotechnical engineering, hydrogeology and geodesy as well as IT specialists, electronics engineers and mechanics. In the office, in the workshop and on site the team is responsible for the development and production of measurement systems, executing complex measuring tasks and the implementation of new measuring techniques.

Solexperts has developed a good reputation with our clients, local authorities, government departments and construction firms for being reliable, dynamic and innovative.

Examples of our activities:
Geotechnical and hydrogeological measurements for civil engineering risk management of projects in difficult ground conditions.

More than 20 years of developing advanced, innovative and leading edge measurement and test systems for the characterisation of host rock for nuclear waste repositories. Many of the Solexperts® systems and techniques have been applicable in civil engineering projects.

Solexperts, together with Prof. K. Kovári, has developed hiDCon, a concrete with high deformation capacity for use in tunnels driven through squeezing and swelling rock where highly deformable and load bearing structural elements are needed.
GEOTECHNOLOGY PRODUCTS
- Line-wise displacement measurement
  - Trivec · Sliding Micrometer · Sliding Deformeter · Borehole Inclinometer · MagX
- Borehole extensometer
  - Sol Extensometer · Magnetic Extensometer · Reverse Head Extensometer
- Point-wise displacement measurement
  - Distometer · Joint Opening Measurement · Surface Extensometer
- Inclination / deviation measurement
  - Clinometer · Clino-Sensor · Clino-Chain · Deflectometer Chain
- Deformation / force measurement
  - Curvometer · Deformeter · Dlatometer · Measuring Anchor
- Rock mechanics tests
  - Hydrofrac / Hydrojack Systems · Load Plate
- Temperature measurement
  - Temperature Sensor · Temperature Measuring Chain
- Vibration measurement
  - Modular-Extensometer
- Borehole measurement
  - Distometer
- Pile load tests

HYDROGEOLOGY PRODUCTS
- Groundwater monitoring
  - Multi-Packer Systems · Multi-Port Sampling Systems · Piezo Press
- Hydraulic borehole tests
  - Heavy Duty & Standard Double Packer Test Systems · Pump-Down Packer Systems
- Undergr. rock mechanics laboratory tests
  - Modular (Mini-) Packer Systems · Pore Pressure Systems · TDR-Packer Systems
- Water well and well repair
  - Pump System without Standpipe · Swage Packer

MONITORING PRODUCTS
- Data acquisition
  - GeoMonitor · Solo-GeoMonitor · Solecxprs DataLogger · Trivec · Dilato · DQ
- Sensors
  - Displacement · Load Cell · Pressure · Tilt · Strain · Total Stations
- Evaluation and visualisation
  - Digital Level · Distance Meter · Vibrating Wire Transducer · Flow · Temperature
- Chemo-physical Sensors
  - Data Management · Web-DAVIS · Trical · Dilato · HUGO (Igor)

TUNNELLING PRODUCTS
- Deformable concrete elements
  - hiDCCon – highly Deformable Load Bearing Concrete

SERVICES
- Consulting
- Instrumentation
- Measurements / Evaluation
- Maintenance / Repairs
Calculations alone do not provide a complete and reliable picture of the interaction between the earth and an underground construction. A much more detailed picture is obtained when geotechnical measurements are included. The interdisciplinary team from Solexperts has broad experience in geotechnical instrumentation and our wide range of testing equipment makes us well prepared to collaborate with planners, public authorities and construction companies to obtain data that provides a much more complete description of conditions at the site.

Tunnels und caverns

Excavation of an underground opening causes stress redistribution in the surrounding rock that results in deformations. The size of the deformations depend on the geotechnical material parameters. Predicted behaviour of the rock and function of the support systems can be verified by geotechnical measurements (displacement measurements, etc.). Timely geotechnical measurements make it possible to intervene if the stability of the ground is endangered. Therefore, geotechnical measurements form an important part of every safety analysis. When tunnelling in urban areas it is often necessary to also monitor the behaviour of neighbouring structures.

Excavations

The hazard scenarios for ground excavations are many fold: Collapse of the slurry wall during construction; ground failure processes when drilling for pile walls; failure of ground anchors; hydraulic failure or loss of bearing capacity at the base of the excavation. For safety reasons it is essential to carry out measurements on the slurry wall (especially inclination measurements) and routinely check displacements at the top of the wall. Solexperts automatically makes these types of measurements using motorised theodolites (total stations), tilt meters, extensometers, line-wise measurements, etc.
Unstable slopes

Erosion at the foot of slopes or changing groundwater conditions can lead to slides involving large volumes of material. If the displacement vectors along a profile and the pore water pressures are measured, the sliding mechanism can be estimated. Continuous monitoring of potential landslides near important traffic arteries and urban areas provides real-time data and evaluations (via alarm-functions) so warnings and preventative actions can be taken before large movements happen. The automatic transfer of data to the Internet allows engineers to review the site conditions both numerically and graphically from anywhere in the World.

Earth and concrete dams, locks

The safety requirements for earth and concrete dams are very high because a failure could have catastrophic consequences. Geodetic and geotechnical measurements form a vital part of the safety management. Instruments developed by Solexperts, like the Sliding Micrometer, are well known for their high reliability and accuracy. Automatic measuring systems, like the Solexperts GeoMonitor, can continuously monitor and overview the measurements and allow comparison of data from year to year.

Survey, piles, embankments

How can you evaluate the behaviour of structures on a scale of 1:1 using geotechnical measurements? The engineers at Solexperts are very familiar with monitoring and test methods to optimize pile dimensions and to determine the bearing capacity or settlement behaviour of large embankments.
Groundwater is an important natural resource that must be protected. Yet at the same time, groundwater can be a risk factor in civil engineering projects as well as a transport medium for contaminants. The broad experience of Solexpers is valued when working with such complex issues. Our wide range of groundwater monitoring systems together with our extensive field investigation experience allows us to create a solution that fits our clients needs.

**Multi-Port Sampling System (MPSS)**

In-situ tests in Emosson  
Measuring station completion  
Rock mechanics laboratory Mont Terri

**Site investigations for nuclear waste disposal**

Solexpers is collaborating with national and international organisations on the disposal of radioactive waste. These include NAGRA (Switzerland), ANDRA (France), BfS/BGR (Germany), ENRESA (Spain), SCK-CEN (Belgium) und CRIEPI/ JAUSA (Japan).

Nuclear waste disposal demands the highest quality requirements for instrumentation, test procedures, data analysis and reporting.

Hydrogeological investigations in formations exhibiting very low permeability require highly specialised technical know-how, testing methods and instrumentation. This acquired «know-how» is integrated into the complete range of activities of Solexpers.

**Hydrogeological characterisation**

In-situ tests are carried out within the framework of preliminary hydrogeological investigations in order to plan efficient dewatering systems for tunnels, embankments or excavation works or better estimate the risk of water in-flow.

An extensive list of references including base tunnel projects like the Gotthard, Lötschberg, Brenner and LTF (Lyon-Turin Ferroviera) witnesses to our technical competence and the reliability of our testing equipment – with borehole tests down to as much as 2500 m depth.
Test and monitoring systems

What are the seepage paths present during groundwater contamination? What are the hydrogeological parameters of contaminated land and hazardous landfill sites? In order to determine these values we utilise the most modern testing and monitoring systems. Today this technology is also applied to hydrogeological investigations for geothermal projects and to the search for suitable host rocks for the permanent storage of CO₂.

Services

We offer individualized complete solutions. Our team of hydrogeologists, geologists and technicians is responsible for instrumentation, hydraulic testing and data interpretation. Having our own machine shop along with engineering, software and hydrogeology departments enables us to take a project from the conceptual design meeting our client’s specific requirements to installing our test and monitoring systems and finally to testing and data evaluation.
The GeoMonitor simultaneously monitors a wide range of sensors and instruments (including vibrating wire and digital sensors). System components connect via a single cable making the setup relatively simple, decrease wiring costs and improving reliability. Sophisticated alarms provide a range of checks and actions. Measured data can be exported in many formats and uploaded to the World Wide Web for near real-time viewing with Web-DAVIS.

GeoMonitor – Hardware and software

The GeoMonitor system consists of a rugged field PC, a Watchdog (for self-monitoring of the system), loggers, sensors, and GeoNodes (connecting out of the ordinary analogue and digital sensors to the system). Analog, vibrating wire, digital, motorized optical levels and total stations can all be simultaneously monitored significantly reducing the overall measurement time. Measurements may be used in complex mathematical real-time calculations and statistics. Sophisticated alarms provide a range of measurement checking options. Alarm actions include email, sms, fax, new recording rates and switches for lights, horns, valves, etc. Data are stored in an ODBC database and can be exported in a number of formats. The real-time graphic options are very powerful and flexible. Plots can be saved in a wide range of formats. The system can be remotely controlled and data can be transferred to the office or an ftp site. The GeoMonitor system is password-protected and built to withstand harsh field conditions and perform reliably over years of use. GeoMonitor is the ideal solution for monitoring structures and geotechnical and hydrogeologic projects of all sizes.
Web-DAVIS data visualisation

Web-DAVIS (the Solexperts Internet Data Visualisation tool) provides near real-time graphical and numeric reports of monitoring data, alarm actions and other information. Personnel responsible for the project can access Web-DAVIS at any time and from any pc connected to the Internet via a password-protected website. The locations of sensors are shown using project-specific diagrams and plans for a quick overview of the project. With just a few mouse-clicks custom and predefined graphics and tabular reports of monitored data and other information (e.g. photos, logbooks, drilling profiles, etc.) can be accessed. Data can even be downloaded to your pc for further analysis. Web-DAVIS provides near real-time viewing of field projects in secure, easy to understand reports from the comfort of your desk.
Tunnels are being driven through increasingly complex geological formations that are difficult to control. Solexperts, in cooperation with Prof. Kovář, has developed hiDCon, a high deformation concrete for applications in squeezing and swelling rock. The hiDCon elements can deform plastically by up to 50% for a specified load, providing a constant resistance force that results in a high strength deformable tunnel lining.

Zones of strongly squeezing rock had to be traversed during the construction of the Lötschberg base tunnel, Switzerland, and in a section of the Lyon-Turin (LTF) tunnel. Conventional relatively rigid tunnel linings based on the resistance principle proved to be inadequate. Solexperts, together with Prof. K. Kovář, has developed hiDCon, a high deformation concrete for these types of conditions. Due to its unique properties hiDCon elements provide a constant resistance force that results in a deformable tunnel lining of high strength. Another example showing the advantages of using hiDCon elements in swelling rock is the restoration of the Chienberg road tunnel, Switzerland. Here a 480 m section of tunnel that passes through strongly swelling an-

GEOTECHNOLOGY – PILE LOAD TESTS

Pile load tests are carried out to determine the ultimate load and serviceability limits in pile foundations: In-situ tests provide information about the ground/pile characteristics allowing optimisation of the required diameter, length and number of piles.

For pile load tests the load is applied in steps using hydraulic press. The load is precisely controlled by monitoring forces at the top of the pile and adjusting the hydraulic pressure in the press. Vertical displacements at the top of the pile are continuously measured using displacement transducers attached to a measuring beam or via a motorised digital level. Strain distribution depends on the type of pile and is measured using a Sliding Micrometer, extensometers or strain gauges. Solexperts offers an integrated system for execution and remote control of pile load tests.
Large sections of the planned, approximately 55 km long, Brenner base tunnel between Innsbruck (A) and Franzensfeste (I) passes through rock highly stressed by tectonic action.

Between October 2004 and December 2005 Solexerts carried out more than 140 hydraulic tests in 35 exploration boreholes to depths of 1200 m along the future Brenner tunnel alignment. Among other things the permeability of the rock and the piezometric heads were evaluated. Solexerts used its specialized «heavy duty» double packer system, data acquisition and evaluation software.

To connect the French motorway A35 to the existing Swiss motorway N2 «Osttangente» the Luzernerring tunnel had to be constructed in the city centre of Basle.

The tunnel passes beneath the entire track system of the existing St. Johann railway station, a bridge, buildings and roads. As part of the project’s risk management Solexerts used a GeoMonitor system to monitor both geodetical and geotechnical measurements. Settlements and displacements of the ground surface, at bridges, buildings and the roads were monitored. Near the railway tracks additional monitoring devices including two robotic tachymeters (total stations), a motion controlled digital level and extensometers were also used. Two geophones were installed to measure vibrations in critical areas. The tunnel’s pipe roof reinforcement was monitored using a Clino-Chain during the excavation stages. Convergence in the tunnel and settlements at the ground surface were manually measured.

All these data and more were available over the Internet to the client, the project engineers, the construction firm and the partners using the Solexerts password secured Web-DAVIS system.
Measuring systems and services in the fields of geotechnology and hydrogeology.

**Solexperts AG**
Mettenbachstrasse 25
Postfach 81
8617 Mönchaltorf
Schweiz

Fon +41 (0) 44 806 29 29
Fax +41 (0) 44 806 29 30
info@solexperts.com
www.solexperts.com

**Solexperts France SARL**
Technopôle Nancy-Brabois
10 allée de la Forêt de la Reine
54500 Vandœuvre-lès-Nancy
France

Tél. +33 (0) 3 83 94 04 55
Fax +33 (0) 3 83 94 03 58
info@solexperts.fr
www.solexperts.com

**MeSy-Solexperts GmbH**
Meesmannstrasse 49
44807 Bochum
Deutschland

Tel. +49 (0) 234 904 47 11
Fax +49 (0) 234 904 47 33
info@mesy-solexperts.com
www.mesy-solexperts.com