Foreword

Dear Reader,

It is essential to consider geological conditions when planning and executing practically all major construction projects in order to rule out damage resulting from the foundation, from the soil and earth used in the foundation, or from risk of earthquakes, slides, rock falls and similar (see Tab. 1). Just how vital it is to conduct geological and geotechnical reconnaissance is underlined by the serious setbacks and accidents that occur every now and again. After the Malpasset Dam rupture and the disastrous rockslide into the Vajont Reservoir it was easy to convince the engineers responsible for similar projects - and even those experts involved in their administration and finance - of the indispensability of geological and geotechnical investigations conducted at the various stages of a construction project's realisation. On the whole, however, many engineers still tend even today to underestimate the importance of the earth sciences for construction engineering. This is strange considering that many structures (e. g. dams and tunnels) are erected on or in rock and others (earth-fill dams) are built almost entirely of soil and earth. The least attention to geological conditions is paid on small construction projects, because here the setbacks are generally less spectacular and are hardly brought to the public's attention.

Engineers are only slowly realising that due allowance for geological factors during the planning, design and execution of earth, foundation and rock related construction projects also results in a more economical solution in many cases.

For many reasons, therefore, it is essential to study all possible interactions between structures and their foundations and the effects of geological risk factors on engineered structures. Engineering geology's main function in this is to describe the geological conditions qualitatively and - as far as possible - quantitatively, to reveal inter-relationships and to establish their significance for a particular project.

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Types of structure	Pre-investigation
Rising structures	Site selection, bearing capacity and settling characteristics of the foundations
Bridges	Site selection, stability and settling characteristics of the support areas and abutments
Traffic routes	Position (hillside or valley), settling characteristics, stability of natural and man-made slopes
Dams	Choice of barrier cross-section, loading capacity of the foundation in the main directions, stability of rock abutments, imperviousness of the reservoir area and dam zone
Tunnels, shafts, caverns	Selection of route and position, geological forecasting, behaviour of various types of rock during excavation of a cavity, water conditions, temperature
River engineering	Erosion activity, erosion obstacles, sedimentation activity, stability of bank slopes, transportation of debris
Coastal and harbour engineering	Questions of erosion and siltation, foundation questions
Dump engineering	Site selection, imperviousness of geological barriers, water conditions, settling characteristics of the foundation

Tab. 1 Geotechnical pre-investigation for various types of structure

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It is usually considered to be the soil or rock mechanic's job to determine the physical properties - and more especially the mechanical characteristics - of soil and earth, and to derive the characteristic values needed for making calculations. The results of geological and geotechnical investigations need to be seen in conjunction, however, and are best combined in a geological-geotechnical report.

All the calculations used in the projection of soil or rock problems are based on data that reflect real geological conditions in greatly simplified form. This idealisation must be such as to ensure that the projection takes the best possible account of the geological situation, i.e. it must isolate the data of importance for the structure and discard all the unimportant details. Particularly when geological conditions are highly complex, the collection of vital geological data requires a familiarity with the possibilities of construction planning and a lively exchange of ideas between the geologist and the engineer. However, the engineer's usual approach is to reduce any given problem to a two dimensional problem, which often results in considerable difficulties because the geological situation generally requires three-dimensional solutions. Problems also arise because many engineers overestimate the role played in planning by calculations. In practice, the collection of geotechnical data often comes up against insurmountable difficulties, resulting in such uncertain input values that even the most elaborate calculations will churn out wrong answers which, however, simulate results. In many cases there would be more sense in parameter studies that work with upper and lower limits, because then it would be possible to study and assess the effect of hard-to-measure geological input values on the calculated results.

The most important types of foundation exploration can be divided into

- direct exploration methods
- indirect exploration methods

Among the direct types, the most frequently used - but by no means the most informative - are the borehole exploration methods. The reason why they are used so often, almost to the exclusion of all other methods, is probably owed to the fact that most engineers know so little about the problems of geological reconnaissance.

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Exploration boreholes are established de facto as the primary method of investigation. Drills are to be found nearly everywhere, and as soon as a few holes have been sunk there's the comforting feeling of having paid some service to geological reconnaissance.

Test pits, tunnels and shafts are far better forms of foundation exploration because they are three-dimensional. Skilfully arranged, they can be incorporated in subsequent construction activities, so in no way are they a waste of effort.

The possibility of conducting all types of major tests in pits and tunnels (large-scale shear tests, triaxial material tests, measurements of the modulus of elasticity in all directions, and primary stress measurements) and of selecting characteristic and representative positions for them can be of great value.

The most important indirect methods of exploration are seismic transmission methods and geoelectrics. When using and evaluating these methods, it must never be forgotten that they are indirect methods. They do not monitor differences in the rock, only certain - physical - properties of the soil layers. It would be quite wrong, therefore, to use any of these exploration methods separately or indeed to pit them one against the other or have them compete against the direct methods of exploration.

The following documentation deals only with part of our services: geotechnical field tests. We are planning, executing and evaluating such tests using a certified quality system for geotechnical tests, the standard **DIN EN ISO 9001**, based on the recommendations of the working committee „Versuchstechnik Fels“ of the German Society for Geotechnics e.V.

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