Some aspects of modern rock slope engineering

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Laporan (Report)

Dr. Raymund M. Spang managing director of Geoplan, Geotechnical Consultants, Witten, Germany presented the above talk at 2.30 pm on 6.10.95 at the Geology Department, Universiti Kebangsaan Malaysia. The talk was attended by more than 50 participants. In his one and half hour presentation, Dr. Spang showed many slides of examples of rock slope stability case histories based on his over 20 years of professional experience. After his talk there was a lively discussion with several questions from the audience.

The following is an abstract of Dr. Spang's presentation.

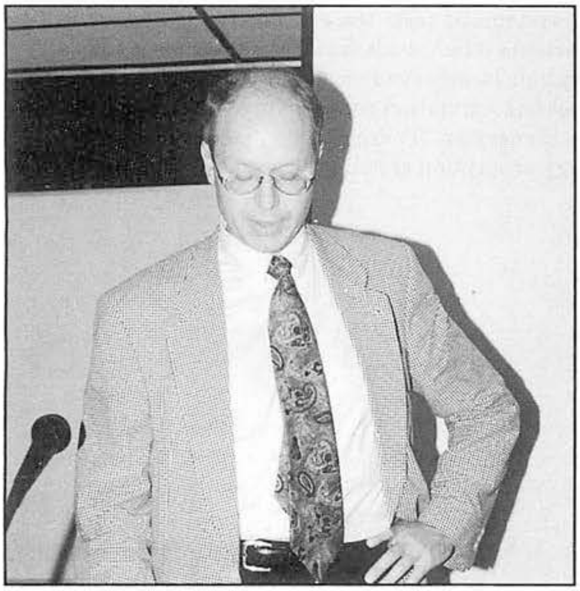
Abstrak (Abstract)

The basic differences between soil and rock as for their mechanical behaviour are that (a) soil in general is a continuum with constant properties in all directions of space. Furthermore it is assumed that soil is homogenous and isotropic. (b) In contrast, rock is considered a discontinuum, i.e. inhomogenous and anisotropic.

There are also further differences in mechanical behaviour of soil and rock due to loading of saturated soils and rock with respect to total stress concept, consolidation theory, seepage and hydrostatical pressure. The influence of fractures on the behaviour of rock masses is shown by a comparison between stress distribution below footings in homogeneous, isotropic material and in anisotropic (bedded) material, as well as by variation in uniaxial compressive strength with changing angles between a pre-existing fracture and the loading direction. Finally it is shown that rock as a broken material has considerable residual strength as an important condition for construction activity in rock.

Failure mechanisms commonly observed in rock slopes are sliding, topping, buckling and some combined modes of failure. Usual steps and means of stability analysis of rock slopes mentioned include field investigations like joint survey, laboratory and field tests backed by aerial photography and mountaineering.

Several examples of rock stabilisation show the size and specific nature of the encountered problems and the stabilisation methods such as wire mesh, rock-bolts, shotcrete, concrete structures, pre-stressed anchors or a combination of these. By using wire mesh it



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The audience at Spang's talk.

distinguishes between rock slopes with a high or a low frequency of small scale rockfalls. High frequency rockfall requires nets with a certain distance between the slope surface and the net to prevent debris accumulation behind the net, whereas in the case of low debris generation, nets may be placed directly on the slope surface.

Rock-bolts are used after clearing the loose material from the slope surface, either for local instabilities or for systematic reinforcement. Deep seated instabilities have been stabilised by prestressed rock anchors with lengths up to 40 m. In some cases the unstable mass had to be removed by mechanical excavation or by blasting.

For load distribution in fractured rock either reinforced shotcrete, prefabricated concrete beams or even massive concrete walls have been used. It is emphasized that drainage is a very important point in rock slope stabilisation and has to be planned and executed very carefully.

For the dimensioning of rockfall protection, systematic tests were conducted to determine the energy absorption capability of each protection system, such as rail and tie walls, and different wire rope net systems. Energy absorption is achieved mostly by deformation elements or friction brakes. A newly developed rockfall simulation program presented deals with the determination of rockfall paths and kinetic energies. These results lead directly to the required retaining structure heights and energy absorption capabilities and can be used to optimise their location.

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