GUEST EDITORIAL

Numerical approach is a powerful tool for predicting the mechanical behaviour of geostructures like tunnels, underground caverns, slopes, etc.. Various types of sophisticated computer programs have been successfully developed, and many of them have already been commercially available. In tunneling practices these computer programs can provide useful information in design of tunnel support structures as well as in making a decision for excavation procedures.

It is well known, however, that the deformational behaviour of tunnels during excavation often differs from that predicted by numerical analyses, though such sophisticated computer programs are used. This difference is mainly due to the fact that many uncertainties are involved in design parameters such as geological formations and mechanical characteristics of soils and rocks. The initial state of stress in the ground also causes difficulties. It is no easy task to determine the design parameters, even though the various advanced exploration techniques are in use.

In order to overcome these difficulties, field measurements are carried out during tunnel excavation. The design parameters used in the original tunnel design can then be assessed on the basis of the results of field measurements, and, if necessary, the design parameters as well as excavation procedures can be modified. This design/construction procedure is called "observational method", which is a very promising means of achieving a rational design of tunnels. In this method, however, a crucial problem remains on how to interpret the field measurement results taken during and after excavation. It should be emphasized that this method fulfills its function, only if the field measurement data are properly interpreted.

In the observational method the stability of tunnels must be evaluated immediately after taking measurements. To meet this requirement, a threshold value for each measuring item must be set up prior to excavation, so that the measured values can be compared directly with them for assessing the tunnel stability. It is obvious that the tunnels are stable if all measured values remain within the threshold. This threshold is often called "hazard warning level".

However, its evaluation is hard, because it is affected by many different factors including geological and mechanical characteristics of soils and rocks, and also system of support structures.

Furthermore, quantitative interpretation of field measurement results is indispensable for assessing the design parameters used in the original design of tunnels. In this interpretation back analysis has a great potential, where input data must be displacements, stress and/or strain, while out put results are material properties like Young's modulus, cohesion and friction angle, and initial state of stress. This analysis is just a reverse process in comparison with the ordinary analysis, where the material properties and initial stress are input data. Thus, this reverse process is called "back analysis". In back analysis it should be emphasized that geological and geomechanical modeling of the ground is extremely important, because back-analyzed material properties entirely depend on what mechanical model is used. For instance, cohesion and internal friction angle cannot be identified by a back analysis, if the mechanical model of the ground is assumed as an elastic material. This means that in a back analysis a mechanical model of soils and rocks should not be assumed, but it must be back-analyzed by the field measurement results. However, the methodology of back analyses for identifying a mechanical model of soils and rocks has not been well developed yet.

Considering these circumstances, it is understood that there still remain many research subjects in tunnelling practices. Geological investigation, rock classification, laboratory and in-situ tests, field measurements, constitutive equation, analytical and numerical methods, back analysis, etc. etc. are all important research subjects in tunnel engineering. Thus, continuous effort should be made on doing research on these subjects and developing new technologies. Furthermore, collaboration between theoreticians and practising engineers working not only in the field of tunnel engineering, but also in soil and rock mechanics, engineering geology, civil and geotechnical engineering, mining engineering, etc. is of extremely importance. In tunnel and rock engineering practices theoretical approaches have a limit, because of complexity of geological and geomechanical characteristics of the ground. This means that engineering judgments based on experiences of practising engineers are essential.

Thus, we hope that this journal can provide both theoreticians and practising engineers with a forum to exchange idea and information concerning rock mechanics and tunnel engineering. Contributions on both theory and practical application are highly welcome. Case studies are also welcome.

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