failure with the costs for the corresponding failure, the economic risk of a construction method can be estimated and can be connected with other monetarily assessable factors such as construction time and use of material. Appropriate measures to control the risk are taken based on these considerations. The considerations are to be implemented by the client in the project development phase and by the contractor in the project construction phase.

The relationship between client and contractor is governed by contracts which address the risk and its apportioning. Risk minimisation in the construction phase is effected by involving project managers and using the services of insurance companies.

The conference is meant to reflect the state-of-the-art of the current development and to indicate new roads. Especially the financial assessment of the probability of failure and the qualified risk management are interesting aspects not only for the construction industry but also for the insurance companies, when seen against the background of the current boundary conditions and the pertinent ever increasing risk involved for the constructions.

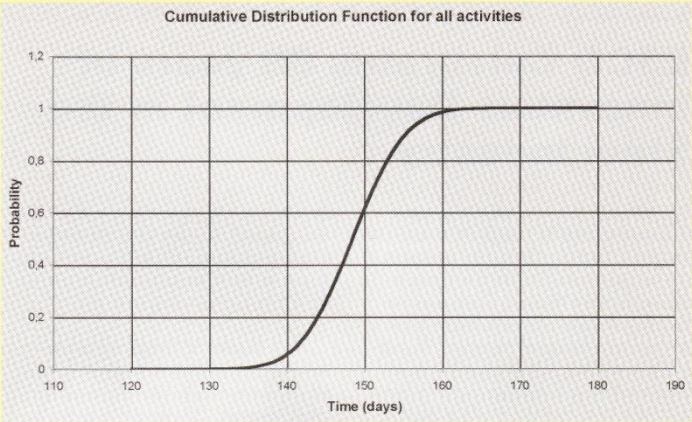

Fig. 3 Cumulative distribution function for all activities.

The conference is aimed to be a round table for clients, insurance companies, engineers and contractors. The main aspect of the conference is the interdisciplinary character of the topics dealt with.

Rudolf Pöttler, Herbert Klapperich

Letter to the Editor

Rock Mass Characterisation and Classification

The recent collection of articles in FELSBAU 4/2001 were of considerable interest, treating as they did the controversial question of rock mass classification. As pointed out by at least one of the authors, the more and more frequent demand for numerical "verification" and the unfortunate attempts to only apply continuum analyses means that too many people are inputting an obviously anisotropic rock mass, yet using an isotropic guesstimate of properties from RMR, GSI, RMi, and Q.

As author of the Q-system, which was originally intended only to provide permanent support solutions for tunnels and caverns in jointed rock, I would join other authors in suggesting careful consideration when using the inevitably approximate estimates of properties that one can supposedly obtain from these classification methods.

Speaking only of the Q value, I would emphasise that a 1980 estimate of rock mass modulus for relatively competent rock (E m = 25 log Q) is a reasonable mean value, provided that the (probably anisotropic) most continuous jointing is discretely represented in a UDEC or 3DEC model. The modulus estimate, even an isotropic one, takes approximate care of all the smaller blocks that one cannot possibly model discretely.

Since 1995 a more accurate equation that takes more account of the obviously important effect of low (or high) uniaxial compression strengths has been available (3). This can easily predict a rock mass modulus of less than 1 GPa, thereby falling beneath the Seraphim and Pereira modification of Bieniawski, as appropriate to very young or weathered rocks. The need to discretely model principal jointing may still apply.

Alber's article (1) on anisotropy contained an obviously incorrect estimate of the Q range (mostly 13 to 17.5) which did not correspond correctly to the RMR range (mostly 60 to 65). Despite this error, the assumption of zero radial convergence using the Q estimate is clearly an impossibility – convergence is needed to give a stable arch, even if no support is needed!

A rough rule of thumb (which can be much improved) is that deformation in mm is approximately equal to span in meters divided by the Q-value. If the Q-value is improved by pre-grouting (or by pre-reinforcement!) the improved Q-value, if estimable, will be the relevant number here. Alber's assumption of squeezing – "all but the Q-classification predict squeezing tunnelling conditions" – suggests the need for more thought from the author. Is 2 cm convergence really considered a squeezing problem? Hardly.

Finally, a comment about the Editors editorial (2). Major shortcomings of classification systems like Q or RMR will easily be "documented" if the person concerned has this as his or her objective. It is also easy to try to criticize RQD if one really feels the need to discuss the dramatic consequences of 9 cm or 11 cm joint spacing!

Nevertheless RQD as a single rock mass parameter, taking Deere's instruction about competent or incompetent rock seriously, is a remarkably good starting point for classification. I suspect that there are thousands of careful users of RQD, RMR and Q who find these methods of use to their profession, despite the efforts of Schubert and Riedmüller. Are there some non-Austrian, and non-Graz users who would like to join the discussion?

Nick Barton, Oslo

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2. Riedmüller, G. ; Schubert, W.: Editorial. In: *Felsbau* 19 (2001), No. 4, p. 4.
3. Barton, N.: *The influence of joint properties in modelling jointed rock masses*. Keynote lecture, Proc. of ISRM Cong. Tokyo, Vol. 3, pp. 1023-1032. Rotterdam: Balkema, 1995.