

Reply to Prof. K. Kovári's criticism

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Quite a few readers must assume that the reviewer, profound adept as he is and obviously back-leaning on a rich scientific production, has every right to release his disparaging thunderclaps to colleagues when dealing—as I did with a book incurring his displeasure—with the New Austrian Tunnelling Method (NATM), which he dislikes anyway. Prof. Kovári, among few others worldwide, is holding a university chair exclusively devoted to tunnelling. With all due respect one should ask, however, whether he did substantially contribute with his publications to promote understanding in tunnelling. In vain we will look in his papers for answers to questions such as

- how many anchors, how long, how strong, and where should they be placed?
- how thick must be the outer and inner linings?
- how can we describe, measure and take into account the mechanical characteristics of rock?
- how can we interpret measurements?

A university teacher who suggests that tunnelling is not rationally conveyable (i.e. virtually: not to be taught at universities) as it is only accessible by long practice, has to object if a colleague presumes to write a book on tunnelling "*without practical experience and without resort to own research work*" (the latter should be known to him as it can be found in Vol. 14 of the journal *Rock Mechanics* of 1982 ; he is the editor of this journal). If Kovári criticizes that I do not refer in my book to any construction project with personal contribution, then he confounds a firm folder with a text book. Certainly, practice of many years is valuable, it may, however, not be considered as the only foundation of tunnelling. It is this attitude (and not the NATM, as Kovári states) which shifts tunnelling into a pre-scientific stage, a stage in which prosper insiders and self-proclaimed popes.

Kovári's statement that "*Kolymbas' main aim . . . is, in his own words, to provide the missing 'theoretical foundation of NATM'*" is freely invented. The reader will vainly look for those words in my book. I clearly presented my aims in the preface.

The name NATM has been adopted worldwide. From Japan to South America each engineer understands by it the conventional tunnelling with support by sprayed concrete. The application of this tunnelling method took place first in Switzerland, briefly thereafter in Austria. (The "Wiener Schnittzel" e.g., was invented in Milan and the Italian cuisine has taken this usurpation by Vienna very well.)

Courageous Austrian engineers succeeded in spreading out this method with pioneer achievements and coined the name NATM. Notabene: NATM is an empirical-intuitive (and very deserving) tunneling method. A subsequent theoretical foundation undertaken by the ÖIAV¹ is not very successful, a fact which does not diminish its merits in practice. Thereupon Kovári substantiated his criticism.

As far as NATM is concerned, Kovári is prejudiced to such an extent that one can be sure of his picking up this issue in each of his publications. E.g., I mention his article "Tunnel construction in squeezing ground" published in the rubric "Rock mechanics" of *Tunnel*², which you expectantly open in the hope to find some hints on how to recognize and quantify the tendency of rocks to squeezing, which loads will exert a squeezing rock upon the tunnel lining and which will be their development with time. Unfortunately you will find nothing substantial but the reassuring statement "*finally it is mentioned that today tunnelling in squeezing rock can draw on a large base of international experience and the theoretical foundations have been established, while modern excavation concepts and techniques provide high performance even in difficult rock conditions*", which should be sufficient as it comes from an appointed authority. You also get the advice "*Providing that the geologic conditions are sufficiently well known, the first objective is to select a tunnel routing which avoids squeezing rocks as much as possible. Ideally, the tunnel will be routed in such a way that no squeezing rock at all will be intersected*", to finally get communicated that "*It can be shown that the protagonists of the NATM—including its founder Rabcevicz—have ignored fundamental principles of both soil and rock mechanics as well as of structural engineering, and are also violating elementary rules of logical thinking. The result is that tunnelling becomes completely trivialized.*" At the international conference GeoEng 2000 in Melbourne, Kovári even declaimed that one of the philosophies of NATM offends against the energy conservation principle. He thereby refers to the rising branch of the ground reaction line, in which Kovári considers the largest sin of the NATM.

There is surely a rising branch of the ground reaction line.³ This was shown also by experiments published by Terzaghi in 1936⁴. Where there cannot be a rising branch, is the homogeneous, isotropic, weightless ground, which stands initially under a hydrostatic stress state. For the appreciation of NATM this case of not rising ground reaction line is absolutely immaterial, because it refers to a weightless ground and is, thus, unrealistic.

Kovári's further examples of the inadequacy of my book are erroneous except for one, the comparison of two anchors with lengths of 3 and 24(!) m, respectively. Obviously this is a misprint for which I apologize. Nobody is immune to misprints and mistakes, not even my reviewer who forgot the horizontal friction force acting between two earth blocks in his analysis of excavation face stability⁵, and this is certainly not just a misprint. The figures 10,3 and 11,1 of my book, dismissed by Kovári without explanation as "basically wrong", are nevertheless correct.⁶

¹Austrian Association of Engineers and Architects

²*Tunnel* 5/98, 12-31

³Bliem, C. und Fellin, W. (2001): On the increasing ground reaction line, *Bautechnik* 78(4):296-305

⁴Proc. Internat. Conf. Soil Mech., Cambridge, Mass. 1936, volume 1, 307-311

⁵G. Anagnostou and K. Kovári, The stability of the excavation face of EPB shields, report no. 129 of the Swiss Society of Soil and Rock Mechanics, 1994. See also: P.A. Vermeer et al., Tunnel face stability on the example of the Rennsteig tunnel, TA Esslingen, January 2000

⁶Compare the spread-wedge anchor shown in the folder 4109-0/03.97 4000 Ho of DSI. As mentioned in the text, Fig. 11.1 refers to the so-called back-cutting, cf. Fig. 5 on page 68 of *Tunnel* 4/2001