Proceedings of the 16th International Conference on Soil Mechanics and Geotechnical Engineering

doi:10.3233/978-1-61499-656-9-3531

Administrative report: TC 37 - Interactive geotechnical design

Compte rendu sur la CT-37

A. Szavits-Nossan
University of Zagreb, Croatia

ABSTRACT

The Administrative Report briefly describes main activities of the ISSMGE Technical Committee 37, Interactive Geotechnical Design, from its start in 2001 until May 2005. It includes Committee's Terms of Reference, list of members, short description of meetings, workshops and the symposium that was organized under its auspices. A summary of main points and conclusions is also given. The Report ends with suggestions for its future work and organization.

RÉSUMÉ

Le report administratif décrit en bref les activités principales du Comité Technique 37 da la Société Internationale de Mécanique des Sols et de la Géotechnique, Le dimensionnement interactif géotechnique, de son début en 2001, jusqu'au Mai 2005. Il comprend les Termes de Référence du Comité, la liste des membres, le bref rendu comptes ses réunions,les conférences et le Symposium organisés par le Comité. Le résumé des sujets principaux qui ont été discutés et des conclusions est aussi présenté. Le report, à la fin, donne les suggestions pour les activités futures du Comité et son organisation.

1 INTRODUCTION

With the greatly appreciated encouragement and helpful suggestions provided by the president of ISSMGE, Professor W. Van Impe, the Technical Committee (TC) 37 of the ISSMGE was established in 2001 under the name "Practice of Active Geotechnical Design - Case Histories". Its present, more appropriate name, was suggested and agreed on at the TC 37 meeting in Hvar, Croatia, in October 2002. The Croatian SSMGE hosted the Committee from its beginning, and its help in coordinating TC 37 is greatly acknowledged.

This report covers the Committee activities in the period from the end of 2001 to May 2005. Throughout this period, professors Heinz Brandl from the Technical University of Vienna, Austria, and Antun Szavits-Nossan from the University of Zagreb, Croatia, coordinated the activities of TC 37. Professor Meho Saša Kovačević, also from the University of Zagreb, acted as Secretary of the Committee.

2 TERMS OF REFERENCE

The following Terms of Reference were defined late in 2001:

- To promote co-operation, exchange of information and discussion in the application of active geotechnical design, including modeling and monitoring techniques, as well as legal aspects;
- To promote general awareness of the practice of active geotechnical design based on the observational method, where the range of possible behavior and acceptable limits of behavior are defined in the design phase, appropriate monitoring is applied during construction and then design changes implementted as appropriate. These may add value if results are favorable or be contingency actions if the actual behavior is outside the acceptable limits;
- To form a bibliography of case histories with well-documented design and monitoring procedures, as well as measurements during construction, especially if design changes (either value-adding or contingencies) were implemented during construction on the basis of observational feedback and assessment.of actual behavior.
- To identify lessons learned from particular case histories when monitored behavior is compared to modeled behavior in terms of parameter determination and modeling techniques;
- To promote the establishment of national supporting committees as a means to widen the discussion base;
- To encourage active participation in related ISSMGE conferences.

3 LIST OF MEMBERS

The list of members of TC 37 is given in the following Table.

Table 1: List of members of TC 37

Member	Country	Role
H. Brandl	Austria	C
A. Szavits-Nossan	Croatia	C
M. S. Kovačević	Croatia	S
J. Burland	UK	CM
M. Jamiolkowski	Italy	CM
A. J. Powderham (from 2003)	UK	CM
F. Schlosser	France	CM
A. Soriano	Spain	CM
F. Colleselli	Italy	M
P. György	Hungary	M
A. Ortigão	Brazil	M
I. Sorić	Croatia	M
G. Stefanoff	Bulgaria	M
R. Szepesházi	Hungary	M
J. M. Vasquez	Portugal	M

C - Coordinator, CM – Core member, M – Member, S – Secretary

Besides the coordinators and the Secretary, M. Jamiolkowski, A. Powderham, F. Schlosser and A. Soriano most actively participated in the Committee activities.

4 COMMITTEE ACTIVITIES

4.1 *Internet web site*

Along with some preparatory work by the coordinators, the first major activity of the Committee was the establishment of its Internet web site. The site (http://www.geoforum.com/tc37/) became operational at the beginning of August 2003. The site was intended to become an open forum for those interested in the use of the Interactive Geotechnical Design. Although very convenient and helpful, at first it provoked little attention and response from the geotechnical community, probably because it was not linked to the ISSMGE web site from the start. Afterwards the situation improved, but not to the expectations of the Committee members.

4.2 *Meetings*

The first Committee meeting was held on 3 October 2002 in Hvar, Croatia, at the venue of the 3rd National Conference of the Croatian SSMGE. It was a meeting spent in discussions about the Terms of Reference, the name of the TC, and the future work of the Committee. Although at first sight a formal matter, the name of the Committee provoked heated discussions. They revealed notably different approaches to interactive geotechnical design and this became increasingly apparent in all future Committee activities.. Among various possible names, as Observational Method, Adaptive design, and Risk Management, its present name was adopted as a compromise. It was also agreed to organize a workshop at the venue of the 13th European Conference of SMGE to be held in Prague, Czech Republic, in August 2003.

The second Committee meeting was held on 24 August 2003 as a part of the Workshop in Prague. Discussions on the main aspects of the interactive design took place after the presentations at the workshop.

The third Committee meeting was held in Paris on 9 May 2005, as part of the Symposium "The Interactive Design Method", organized by IREX, Paris, France, on the occasion of the publication of the French guide on the Observational Method (Allagnat 2005). The main topics of the meeting were the preparation of the Symposium conclusions, as main guidelines for interactive geotechnical design, and suggestions for further activities.

4.3 *The Prague Workshop*

The Prague workshop (Interactive Geotechnical Design) was held on 24 August 2003 at the Czech Technical University in Prague, as part of the 13th ECSMGE. The following lectures were presented: The Observational Method, Calculated Risk and "Geopoker" (H. Brandl), The Observational Method - Learning from Projects (A. J. Powderham), Stabilization of the Leaning Tower of Pisa (C. Viggiani, Italy), A New French Document on the Observational Method (F. Schlosser), Foundation Failure of a Vertical Breakwater (A. Soriano), and The Observational Method and Eurocode 7 (A. Szavits-Nossan).

Numerous very interesting and instructive case histories related to interactive geotechnical design, some of them from well-known projects, were presented during the lectures. Some very interesting observations and proposals, backed by these case histories, were made, and the importance of the use of the interactive design was emphasized.

4.4 *The Paris Symposium*

The Paris Symposium "The Interactive Design Method", was organized by IREX, Paris, France, on the occasion of the publication of the French guide on Observational Method (Allagnat 2005), and by the great support of Professor François Schlosser. His contribution to the activities of TC 37 is greatly acknowledged. The Symposium was held from 9 to 10 May 2005 at the Fédération Nationale des Travaux Publics in Paris, France. The President and the Vice President of ISSMGE for Europe, professors W. Van Impe and P. Seco e Pinto, and the President of the French SSMGE, Mr. J. Launay, greeted the participants of the Symposium with encouraging words. By the kind proposal of Professor François Schlosser, several members of TC 37 were invited to actively participate in the Symposium by their contributing lectures.

The first day of the Symposium was dedicated to the introduction of the French Guide and to the French experience in the use of the Interactive Geotechnical Design. The following lectures were presented: General presentation of the guide (D. Allagnat), The multi-anchored retaining wall of the Florestan building in Monaco in the 1980s (F. Blondeau), Use of the interactive design for the construction of embankments on soft soil on the East HSL (M. Bastick), Foundation of the south abutment of the Normandy bridge (O. Combarieu), Soil nailed wall in an urban area (P. Vezole), Control of settlement risk due to tunnelling in an urban area (R. Kastner), and Contractual aspects of the interactive design (H. Moreau de Saint-Martin). These lectures covered a wide area of application of the Interactive Geotechnical Design. The French guide attracted a great attention proving the wide interest for this particular design method.

Invited lectures, mostly presented by TC 37 members were: The Observational method, Balancing Risk and Innovation (A. J. Powderham), Observational method in tunnelling engineering in Greece (A. Anagnostopoulos, I. Mihalis, Greece), Proactive Geotechnical Design of Harbour Structure (A. Soriano), Interactive Geotechnical Design of Large Caverns in rock (G. Barla, Italy), The behavior of the Leaning Tower of Pisa after the stabilisation works (M. Jamiolkowski), The dominating role of the Observational Method as an essential element of geotechnical assurance and safety systems (R. Katzenbach, Germany), The Croatian experience in the use of the interactive design method (A. Szavits-Nossan and M.-S. Kovačević), and The use of the Observational Method for the foundations of the Millau viaduct (F. Schlosser).

The lectures and following discussions covered most of the disputed questions related to Interactive Geotechnical Design raised during TC 37 meetings. Tentative conclusions from the Paris Symposium and the earlier Prague Workshop will be presented in the following section. This Symposium was the most important event for TC 37, as agreed on by all participating Committee members.

4.5 *Other activities*

Along with the formal TC 37 meetings, the coordinator of the Committee, A. Szavits-Nossan held several meetings with some Committee core members discussing topics related to the Observational Method. On these occasions Committee core members were asked to deliver lectures aimed at the promotion of the OM to the general geotechnical community. The following special lectures, commemorating the late professor E. Nonveiller, were held in Zagreb, Croatia, under the auspices of the Croatian SSMGE: The Fourth Nonveiller Lecture delivered by A. J. Powderham: The Observational Method - learning from projects (23 November 2003), and the Fifth Nonveiller Lecture

delivered by F. Schlosser: The foundations of the Millau viaduct in France (17 November 2004). In November 2003 Mr. Powderham was asked to deliver a lecture on the application of the OM to senior undergraduate civil engineering students of the University of Zagreb. These very interesting lectures raised a great interest and lengthy discussions proving that the OM appeals very much to engineers. The generosity of Mr. Powderham and Professor Schlosser to accept these invitations is greatly acknowledged.

4.6 *Conclusions from the Prague Workshop and Paris Symposium*

Based on lectures and discussions from the Prague Workshop and particularly from the Paris Symposium, some tentative points related to the Interactive Geotechnical Design (or Observational Method) emerged. The list is not complete yet, and would need further discussions to reach a consensus. The discussed points are as follows.

a. Despite the fact that the principles of the Observational Method were formally laid down by Peck (1969) more than thirty five years ago in his Rankine lecture, and despite abundant literature about the subject published since (e.g. CIRIA 1999), a lot of concerns about its relevance on the one hand, or its misuse on the other, that hinder its wider use, are still present.

b. There are several concerns related to the wider application of the Observational Method. The first concern is related to the application of one of Peck's eight OM principles that initial design (or base case design) should be based on carefully established most probable ground conditions and related ground properties. As construction proceeds and more relevant observations are collected and interpreted resulting in better understanding of real ground behavior, planned contingency actions may be applied if relevant observations exceed predefined acceptable limits. The application of contingency actions means increased costs and construction delays. This course of circumstances may be considered to make the anticipated total construction cost and construction time uncertain and not popular among clients. It even may imply unacceptably low factors of safety or too high risk at certain construction stages. This possible scenario may also pose contractual problems dependent on local construction laws.

c. To avoid the aforementioned constraints, Powderham (1994, 1998) introduced and advocates the progressive modification approach to the OM. In this approach the construction starts with an initial design more conservative than that the one based on most probable ground conditions. Design modifications may then take the direction towards reducing some construction elements and thus reducing the total construction cost and time. Muir Wood (2000) also stressed this point for tunnelling. By this approach the design modifications may be gradual and thus more controlled and manageable and can, thus, provide considerable savings during construction. Obviously, contingency measures for the worst possible scenario should still be planned, but their application would be less likely. This approach still poses contractual problems, particularly in dividing risks and profits among the parties concerned.

d. One of the most crucial ingredients of the OM is the selection of critical observations that should give sufficiently reliable information on the actual ground behavior, that are most relevant for the safety of the structure under construction. Experience demonstrates that trends in soil and rock behavior shown by observations are more important than the absolute measured values. The overall system of observations should be as simple and transparent as possible in order to facilitate clear communication. Information overload should be avoided.

e. The Observational Method addresses uncertainties, works outside convention and requires close coordination between design (geotechnical as well as structural) and construction; it needs more design input than conventional design, and construction savings should outweigh the increased design and observation costs. Therefore, it is probably more applicable for large and costly projects.

f. Due to the requirement of close coordination between design and construction and the associated teamwork, the Observational Method promotes innovation.

g. The Observational Method may not always be appropriate. It addresses uncertainties. Where sudden failure and progressive collapse is expected, the method is not applicable. In an ideal situation, where everything can be predicted with certainty, the method is too costly.

h. The use of the Observational Method can not substitute the need for a good design firmly based on proper and quality site investigation works and laboratory testing, otherwise we are confronted with unknown and unnecessary risk.

i. Quality control observations do not make up per se the Observational Method.

j. The data-base acquired during observations can provide a valuable tool for a better understanding of soil and rock behavior.

k. The back-analyses performed with measured displacements during construction can provide better values of soil and rock parameters, which are especially valuable for rock masses, where correlations lead to poor predictions of the rock deformation modulus.

5 RECOMMENDATIONS FOR THE FUTURE OF TC37

Based on the valuable experience acquired during the work of TC 37, it is concluded that the continuation of activities of TC 37 is fully justified, but probably with a slight change in its terms of reference. The following terms of reference would serve as a sound basis for the promotion of the Observational Method:

- To promote co-operation, exchange of information and discussions in the application of the Observational Method, including related legal aspects and risk analyses, in order to facilitate the consolidation and enhancement of the existing knowledge;

- To form a bibliography of case histories with best practices related to the application of the Observational Method;

- To study case histories relevant for the Observational Method that rise special interst for their success as well as for their failure;

- To get more knowledge on soil and rock behavior and more realistic parameters from back-analyses during construction, using measured data;

- To try to reach a consensus on the formulation of the best approach to the Observational Method that would equally appeal to all involved parties, geotechnical and structural

designers, contractors and clients, and test it against case histories of the best practice;

– To promote general awareness of the advantages of interactive geotechnical design based on the observational method by participating in related ISSMGE conferences and promoting national supporting committees.

Special attention should be given in selecting Committee members with experience in the application of the Observational Method, who are prepared to actively participate in the Committee work.

ACKNOWLEDGMENTS

The author thanks Mr. A. Powderham for his very helpful comments in reviewing this text.

REFERENCES

Allagnat, D. (2005). La méthode observationnelle pour le dimensionnement interactif des ouvrages; Presses de l'école nationale des ponts et chaussées, Paris, 128 pp.

CIRIA (1999). The Observational Method in ground engineering - principles and applications. CIRIA, Report 185, London, 214 pp.

Muir Wood, A. (2000). Tunnelling: Management by design, E & FN Spon, London, 328 pp.

Peck, R. B. (1969). Advantages and limitations of the Observational Method in applied soil mechanics. *Géotechnique*, 19(2), 171-187.

Powderham, A.J. (1994). An Overview of the Observational Method: Development in Cut and Cover and Bored Tunnelling Projects. *Géotechnique,* 44(4), 619-636.

Powderham, A.J. (1998). The observational method - application through progressive modification. Proc. Journal ASCE/BSCE, 13(2), 87-110.