ADMINISTRATIVE REPORT OF TC-34 ON PREDICTION AND SIMULATION METHODS IN GEOMECHANICS

F. Oka
Chairman of TC-34, Graduate School of Engineering, Kyoto University, Japan

A. Murakami
Secretary of TC-34, Graduate School of Environmental Science, Okayama University, Japan

ABSTRACT: This note contains the information concerning the activities of TC34 on the Prediction and Simulation methods in Geomechanics in the period 2005-2009 in form of an administrative report to the secretary general of the ISSMGE.

1. INTRODUCTION

In the last two decades prediction methods for the behavior of geomaterials have been greatly developed based on the ongoing research on constitutive models, numerical analysis methods and recent advances on calibration, verification and validation by experiments and of field data measurements. Nowadays computational methods are indispensable tools in geotechnical engineering although more use is expected by practitioners.

There are several issues, which are related to large deformation and failure in geomechanics, such as: a) Modeling (constitutive modeling and calibration; modeling of mechanical instabilities, strain localization and progressive failure; modeling of chemo-thermo-hydro-mechanically coupled phenomena). b) Verification and validation of the used methods. c) Development of more stable and accurate numerical methods. d) The promotion of exchange between academic and practicing engineers, members of the Society.

The importance of these developments were recognized by the Technical Committee 34 of ISSMGE on 'Prediction and simulation methods in geomechanics' which was established 2005 after the Osaka conference as a continuation of the previous one on Prediction methods in large strain geomechanics.

This is an administrative report on TC-34 of ISSMGE activities for the period 2005-2009. First of all, the objective and terms of reference, and the members of TC-34 including those of Japanese supporting committee are introduced. Then, the activities by TC-34 during this period are summarized. Finally, the future prospects for TC-34 including their topics and activities are presented.

2. TERMS OF REFERENCE

Terms of reference for the TC-34 are shown as follows:

1) Prediction of mechanical and thermo-hydro-mechanical instabilities: Large deformations, strain localization, progressive failure, liquefaction, ground water flow analysis with contamination, temperature dependency, erosion and rapid flow of complex geo-fluids.

2) Advanced and comprehensive constitutive modeling of Geomaterials including: elasto-plasticity, viscoplasticity, hypo-plasticity and cyclic plasticity, soil degradation, strain softening, rate dependency and anisotropy.

3) Development of advanced prediction methods based on new numerical and analytical techniques, such as the Mesh-free Method, BEM, SPH and MPM etc.

4) Numerical implementations and constitutive parameter determination using laboratory and field test results. Inverse analysis and upscaling, homogenization of the inherent local heterogeneity of Geomaterials.

5) Critical evaluation of existing prediction methods such as empirical methods, elastic, simplified elasto-plastic analysis and limit analysis etc., by comprehensive numerical analysis methods.

6) Transfer of knowledge and training activities; Promotion of technology transfer including new findings to the practicing engineers of the Society, that address important issues, including natural hazards. Promotion of exchanges between academic and practical members (i.e. industry second mends of young academic researchers on practical issues and continued education and training of experienced engineers on existing applicable and comprehensive methods and new findings).

3. MEMBERS AND SUPPORTING COMMITTEE

A well-selected international group of experts were appointed as responsible members of this committee based on the candidates recommended by ISSMGE member’s societies, presided from 2001 to 2005 by Prof. F. Oka of Kyoto University as the Chairman and Prof. A. Murakami of Okayama University as the Secretary, who were finalized by the ISSMGE President. List of members are shown in the APPENDIX. TC-34 has also set up the supporting committee in the framework of the Japanese Geotechnical Society (JGS) in order to enhance the activities of TC-34. The members of Japanese Supporting Committee are also listed in the APPENDIX.
4 REVIEW OF ACTIVITIES

4.1 TC-34 Website and Newsletters

TC-34 homepage has been constructed at the site below and all the formal information and the activities have been updated in this website.
http://nakisuna2.kuciv.kyoto-u.ac.jp/tc34/index.htm

Newsletters have been issued via e-mail. During the period of 2005-2009, a total of 12 newsletters were published.

4.2 TC34 meeting and workshop during the 14th ECSMGE, Sep. 2007 in Madrid

TC34 Meeting and workshop was held from 14:15 to 16:00 on September 26, 2007 at Room #9 bis, the Palacio de Congresos y Exposiciones - Madrid, Spain.

PRESENTATIONS:
1) ‘Bending failure in geomaterials: flow of fluidized geomaterials. Applications to wave generated by landslides’: M. Pastor (CEDEX, Spain)
2) ‘Modelling of Trevoux and Petacciato landslides by the second order work criterion’: F. Prunier, S. Lignon and F. Darve (Laboratoire 3S, France)
3) ‘The influence of faulting on existing underground excavation’: A. Cividini (Politecnico di Milano, Italy)
4) ‘Monitoring system and remedial works for the large scale slope failure in Gifu, Japan’: K. Sawada and A. Yashima (Gifu University, Japan)
5) ‘Bearing capacity and displacements on non rotating surface footing on a layered medium’: K. Papantonepoulos and G. Moulious (University of Patras, Greece)

DISCUSSIONS on the presentations and ‘Future activity of TC34’: F. Oka (Kyoto University, TC chair)


4.3 Meeting during the 8th IWBIDG

THEME: Future activities
DATE: May 28-31, 2008
PLACE: Lake Louise Canada

4.4 International Symposium (IS-Kyoto2009)

The International Symposium on Prediction and Simulation Methods for Geohazard Mitigation was held in Kyoto on May 25-27, 2009 by the third term activity of TC-34 under the sponsorship of the ISSMGE, the Japanese Geotechnical Society, Kansai branch of JGS.


The organization of the Workshop is done by the members of the organizing committee with the aid of the international advisory committee as listed below.

- Organizing Committee
  Chairman: F. Oka (Chair, Kyoto Univ., Japan)

K. Tokida (Vice Chair, Osaka Univ., Japan)
A. Murakami (Vice Chair, Okayama Univ., Japan)
H. Kusumi (Vice Chair, Kansai Univ., Japan)
Organizing members (26 members)
International Advisory Committee (33 members)

Objectives of the symposium:
Mitigation of geo-hazards is an important problem in geotechnical engineering. Heavy rain, typhoon and earthquake are the main causes of geo-hazards. Due to the climate change and the extreme weather, geo-hazard occurs in all of the worlds. The understanding of mechanism of geo-hazard due to various causes is critical for the mitigation. Due to the limitation of experimental techniques available, simulation-based prediction, monitoring and analysis of case records are playing an increasingly important role.

The Kansai branch of JGS established the technical committee on mitigation of geo-hazard in river basin 2006 and has been doing site investigation on the geo-hazard due to heavy rain and typhoon. On the other hand, TC34 of ISSMGE has been working on the prediction and simulation methods for in geomechanics, in particular, TC34 focuses on the analysis of unstable behavior of ground such as strain localization which is a precursor of the failure of ground, liquefaction, landslides, seepage failure etc.

The Kansai branch of JGS and TC34 of ISSMGE decided to organize an international symposium on the prediction and simulation methods for mitigation of geo-hazard. The symposium provides a forum to discuss new prediction and simulation methods of geo-hazard and exchange ideas and mutually interested information etc. This symposium is sponsored by the Japanese Geotechnical Society (Kansai branch), the TC34 of ISSMGE and TC34 supporting committee of JGS.

Main themes of the symposium are:
1) Mechanism of geo-hazards; heavy rain, floods, typhoon, earthquake, landslides, slope and snow slides, tsunamis, land subsidence and coastal erosion etc.
2) Numerical and analytical simulation methods for geo-hazards: conventional and advanced methods, FDM, FEM, Extended FEM, DEM, SPH and MPM
3) Advanced constitutive modeling of geomaterials and numerical implementations and constitutive parameter determination using laboratory and field test results including cyclic plasticity, nonlinear incremental plasticity, viscoplasticity etc.
4) Thermo-hydro-mechanical instabilities: large deformation, strain localization, progressive failure, liquefaction, ground water flow analysis, rapid flows of complex geo-fluids such as mud flow etc.
5) Monitoring methods of geo-structures during flood, earthquake and heavy rain etc and design methods.
6) Evaluation of existing prediction methods, performance based design method aided by advanced numerical modeling, Risk analysis and management of mitigation programs.
7) Case records of geo-hazards and mitigation projects

4.5 Special Issue on Prediction and Simulation Methods for Geohazard Mitigation of Soils and Foundations

Due the high quality of the presentations during this IS-Kyoto2009, it was decided, with the approval of the Japanese Geotechnical Society, to dedicate a special issue of Soils and Foundations, where full length papers of the communications could be published. The rapid review of the editorial committee of Soils and Foundations made it possible to publish this special issue on the ‘Prediction and Simulation Methods for Geohazard Mitigation,’ which will be published August issue of 2009. It is
expected that a number of related papers will also be published in the coming issue.

The main aim in publishing this special issue of *Soils and Foundations* was to provide to researchers and engineers a forum of international exposure to present the recent advances on the subjects of ‘Prediction and simulation methods for Geohazard Mitigation’.

### 4.6 Organizing Sessions in the Regional Conferences and Related Conferences

1. **Discussion Sessions at the Annual Conference of the Japanese Geotechnical Society: July 2006 through 2009.**

   **THEME:** New simulation methods in geomechanics – large deformation, multiphase coupled analysis, multi-physics analysis.
   **DATE:** July 10, 2008
   **PLACE:** Hiroshima, Japan
   **CONTENTS:**
   1) Opening address by F. Oka (Japan)
   2) General report on the accepted papers (16 papers)
   3) Discussion
   Chairpersons: T. Noda (Japan) and K. Maeda (Japan)

   **THEME:** Prediction and mitigation methods for geohazards in river basin
   **DATE:** 2009 August 18 (to be held)
   **PLACE:** Yokohama, Japan
   **CONTENTS:**
   1) Opening address by F. Oka (Japan)
   2) General report on the accepted papers (18 papers)
   3) Discussion
   Chairpersons: F. Oka (Japan)

2. **Meeting and Workshop**

   Meeting during the IS-Kyoto2009
   **THEME:** SOA report of TC34, Future activities, observer of TC34 (A. Puzrin, ETH, Switzerland)
   **DATE:** May 26, 2009
   **PLACE:** Kyoto Int. Conference center, Kyoto, Japan

   **Regional Symposium**
   **THEME:** Prediction and simulation methods for large deformation in geomechanics
   **DATE:** October 26, 2007
   **PLACE:** Kyoto, Japan
   **CONTENTS:**
   1) Opening address by F. Oka (Japan)
   2) General report on the accepted papers (11 papers)
   3) Discussion
   4) Closing address by A. Murakami (Japan)
   Chairpersons: T. Nakai, T. Noda, T. Tuneshi (Japan)


   **DATE:** May 25-27, 2009
   **PLACE:** Kyoto, Japan
   **CONTENTS:**
   1) Opening address by F. Oka (Japan)

2) **Keynote lectures**

   Ioannis G. Vardoulakis (Core member of TC34, Greece)
   / Thermo-poro mechanical analysis of catastrophic landslides
   Kam Tim Chau (Core member of TC34, Hong Kong)
   / Some geohazards associated with the 8.0 Wenchuan Earthquake on May 12, 2008
   Chjeng-Lun Shieh (National Cheng Kung University, Taiwan)
   / Risk assessment for hydraulic design associated with the uncertainty of rainfall
   Hajime Nakagawa (Kyoto University, Japan)
   / Recent flood disasters in Japan

3) **General presentations (71 papers)**

4) **Discussion**

   Members of the Kansai branch of JGS and TC34 of ISSMGE organized an international symposium on Prediction and Simulation Methods for the Geohazard Mitigation. The symposium provides a forum for discussing new prediction and simulation methods for geohazards and for exchanging ideas and information on topics of mutual interest. A total of 188 participants contributed from 18 countries. The members of the Organizing Committee and the International Advisory Committee reviewed 116 papers.

4. **Publications**

   Following is the list of our publications:

   3. Special reports on the related topics on prediction and simulation methods in geomechanics (to be published).

4.8 **Meetings of Japanese Supporting Committee**

   The meetings were held by Japanese Supporting Committee for three or four times in each year and the discussion by this supporting committee was a guideline for the whole activities by TC-34. Meetings were held as following schedule:

   1. **1st meeting:** July 12, 2006, Kagoshima
   2. **2nd meeting:** November 27, 2006, Tokyo
   3. **3rd meeting:** March 29, 2007, Tokyo
   4. **4th meeting:** July 4, 2007, Nagoya
   5. **5th meeting:** March 31, 2008, Kyoto
   6. **6th meeting:** July 10, 2008, Hiroshima

   The meeting of IS-Kyoto committee was held as following schedule:

   1. **1st meeting:** December 17, 2007, Osaka
   2. **2nd meeting:** April 4, 2008, Osaka
   3. **3rd meeting:** October 17, 2008, Osaka
5 CONCLUDING REMARKS

5.1 Summary of Activities

TC-34 activities in the period 2006 to 2009 are summarized:
(1) Two organized sessions in the annual conferences of the JGS,
(2) Six meetings, workshops and related conferences,
(3) Eight meetings for the Japanese Supporting Committee, and
(4) Three publications

5.2 Planned Activities for

1. TC34 Workshop during the 17ICSMGE at Alexandria, October 3, 2009
2. Strong support for the 17th ICSMGE in 2009 by members of TC34
3. Panelists in the Technical Sessions by core members.
4. Support for GeoX2010, Texas, USA, March 3-5, 2010

5.3 Next Host Member Society

The TC-34 has obtained good results in this period 2005-2009, providing successful contributions towards the development of prediction and simulation methods in geomechanics. A large number of the members of TC34 want to continue the TC. The expected Host member societies are Hong Kong society and the Japanese Geotechnical Society of TC-34 for the forthcoming term of 2009-2013.

APPENDIX : LIST OF MEMBERS

- TECHNICAL COMMITTEE #34
CHAIRMAN
  Oka, F., Japan
SECRETARY
  Murakami, A., Japan
CORE MEMBERS
  Chau, K.T., Hong Kong
  Darve, F., France
  Muniz de Farias, M., Brazil
  Lade, P.V., USA
  Muir Wood, D., UK
  Nova, R., Italy
  Van den Berg, P., The Netherlands
  Vardoulakis, I., Greece
MEMBERS
  Cividini, A., Italy
  Chartier, R., Belgium
  Gens, A., Spain
  Gudehus, G., Germany
  Kim, S.R., Korea
  Kolymbas, D., Austria
  Labuz, J.F., USA
  Lámer, G., Hungary
  Länsivaara, T., Finland
  Michalowski, R.L., U.S.A.
  Mühlhaus, H.B., Australia
  Noorzad, A., Iran
  Pastor, M., Spain
  Serra, J.P.B., Portugal
  Sulem, J., France
  Tamagnini, C., Italy
  Wan, R., Canada

- OBSERVER
  Puzrin, A., Switzerland

- JAPANESE SUPPORTING COMMITTEE
CHAIRMAN
  Oka, F., Kyoto University
SECRETARY GENERAL
  Murakami, A., Okayama University
SECRETARY
  Kodaka, T., Meijo University
MEMBERS (27 members)
  Asaoka, A., Nagoya University
  Higo, Y., Kyoto University
  Iizuka, A., Kobe University
  Iwakuma, T., Tohoku University
  Uzuoka, R., Tohoku University
  Otani, J., Kumamoto University
  Oda, M., Saitama University
  Kishino, Y., Tohoku University
  Kohgo, Y., Tokyo University of Agr. and Tech.
  Komiya, K., Chiba Institute of Technology
  Sakaguchi, H., Japan Marine Science & Technology Center
  Sunami, S., Nikken Sekkei Ltd.
  Sekiguchi, K., JFK R&D Corporation
  Takahashi, A., Public Works Research Institute
  Tatsuoka, F., Tokyo University of Science
  Tamura, T., Kyoto University
  Zhang, F., Nagoya Institute of Technology
  Tobita, Y., Tohoku Gakuin University
  Nakai, T., Nagoya Institute of Technology
  Nakano, M., Nagoya University
  Noda, T., Nagoya University
  Horii, M., The University of Tokyo
  Maeda, K., Nagoya Institute of Technology
  Matsushima, T., Tsukuba University
  Miyake, M., Toyo Construction Corporation
  Yashima, A., Gifu University
  Yoshida, N., Kobe University