

# Technical Committee: TC2 – Physical Modelling in Geotechnics

## Comite Technique: CT2 – modélisation physique en géotechnique

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### 1 OVERVIEW

Technical Committee 2 (Physical Modelling in Geotechnics), one of the first-established ISSMGE Technical Committees, has continued to be highly active during the past 4 years. The terms of reference of this committee remain to support the advancement of physical modelling in geotechnical engineering, via training, education, technical publications and by facilitating interaction between those involved in the execution and application of geotechnical physical modelling.

The committee has supported the rapid expansion of the network of physical modeling facilities worldwide, through a series of workshops that provide training and education for researchers. A total of 7 events have been held, spanning every (inhabited!) continent. Also, the long-running quadrennial TC2 conference was held successfully in Hong Kong in 2006, and will take place in Zurich in 2010. The Hong Kong event attracted a record number of papers – 230 in total – and the event in Zurich is expected to be a similar success.

TC2 representatives contributed comprehensive reviews published in both the 60<sup>th</sup> Birthday edition of *Géotechnique* and an ISSMGE State-of-the-Art Plenary Paper. In addition to these papers, the proportion of the publications in the major geotechnical journals that include physical modelling has increased.

Another landmark publication was a catalogue and review of scaling laws for physical modelling, published in the *International Journal of Physical Modelling in Geotechnics (IJPMG)* in 2007. This journal is in the process of emerging from its TC2 incubator and the support of Prof. O. Kusakabe's group, to become a fully-fledged publication within the Thomas Telford stable, alongside *Géotechnique* and the *Proceedings of the Institution of Civil Engineers*.

### 2 INTRODUCTION

This report provides an overview of the activities of TC2 during the period 2005-2009, and a preview of planned activities through to the quadrennial TC2 conference, which will be held in Zurich in 2010.

Professor Colin Leung of NUS, Singapore, chaired the Committee for Physical Modelling in Geotechnics until July 2006 after which Professor Sarah Springman (ETH Zurich) took over the chair. Dr, later Professor, David White (formerly at Cambridge University, now at the University of W. Australia) was chosen as the Secretary for this period. At this time, a group of 6 Core Members was formed, and national representatives were put forward by the individual country societies.

### 3 TERMS OF REFERENCE

The terms of reference for the Committee are as follows:

1. To promote exchange of information and co-operation amongst experimentalists and users of geotechnical physical modelling (including centrifuge testing).
2. To act as a contact point, via the TC2 website, for the profession- academics and industry- to obtain reliable information on geotechnical physical modelling.
3. To encourage effective dissemination of applications of physical modelling to practising engineers and researchers through established journals and conferences. In particular, to promote the *International Journal of Physical Modelling in Geotechnics* (launched by TC2 in 2001), as the major platform for interaction among physical modellers and a useful source of reference for geotechnical engineers.
4. To promote the organisation of the next TC2 international conferences on Geotechnical Physical Modelling to be held in Hong Kong in 2006 and in Zurich in 2010.
5. To support and encourage the organisation of international, national and regional events on geotechnical physical modelling, including i) the inauguration of new experimental facilities ii) specialist sessions within general conferences iii) regional networking events in addition to the quadrennial TC conferences and iv) the development and mentoring of new facilities and their early career researchers in under-represented regions.
6. To develop with other TCs, including TC1 (offshore / near-shore), TC4 (earthquake), TC6 (unsaturated soil mechanics), TC28 (underground construction) and TC35 (micromechanics) a mutual understanding of the role of physical modelling in addressing their geotechnical challenges.
7. To co-operate with other national and international groups interested in geotechnical physical modelling, including TRB TC A2K05 (modelling techniques in geotechnics) and ASTM task group D18.09 (centrifuge modelling).
8. To encourage presentation of papers on geotechnical physical modelling applications to general sessions of the XVII ICSMGE conference, to be held in Alexandria in 2009.

### 4 MEMBERSHIP

The membership of TC2 comprises of 6 Core Members in addition to the Chair and Secretary, and a further 33 country members appointed by the national societies. A list of these members is given in Table 1.

Table 1: List of TC2 committee members

Name	Affiliation
Prof. Sarah M. Springman *(Chair)	ETH Zurich, Switzerland
Prof. David J. White *(Secretary)	UWA, Perth, Australia

## Core Members

Dr. Christophe Gaudin	UWA, Perth, Australia
Prof. Osamu Kusakabe	Tokyo Inst. Technology, Japan
Prof. Bruce Kutter	Univ. of California, Davis, USA
Prof. Colin Leung	NUS, Singapore
Prof. Charles Ng	Hong Kong Univ. Science & Tech.
Dr. Ryan Phillips	C-CORE, Canada

## National Members

Dr. Andy Take	Queens' U., Canada
Prof. Arun J. Valsangkar	U. New Brunswick, Canada
Prof. Zhengyin Cai	NIHRI, China
Prof. Yujing Hou	CIWRHR, China
Prof. Bernardo Caicedo	Univ. des Los Andes, Colombia
Prof. Jacques Garnier	LCPC, France
Prof. Pierre Foray	Univ. of Grenoble, France
Dr. Johnny Cheuk	Hong Kong Univ., Hong Kong
Dr. P. Van	Budapest Univ. Tech., Hungary
Dr. B. Viswanatham	IIT Bombay, India
Dr. Abbas Ghalandarzadeh	Univ. of Tehran, Iran
Dr. Conleth O'Loughlin	IIT Sligo, Ireland
Prof. Vincenzo Fioravante	Univ. of Ferrara, Italy
Prof. Jiro Takemura	Tokyo Inst. Technology, Japan
Prof. M. Nurguzhin	Karaganda State TU., Kazakhstan
Dr. Cheol Ju Lee	Kangwon Nat. Univ., S. Korea
Dr. Surendra Bahdur Tamrakar	Tribhuvan Univ. Nepal
Dr. A. Bezuijen	Deltares, Netherlands
Dr. Elisabeth Bowman	Univ. of Christchurch, N. Zealand
Prof. R.J. Izbicki	Tech. Univ. Wroclaw, Poland
Dr. João Portugal	LNEC, Portugal
Prof. Anton Chirica	Tech. Univ., Bucharest, Romania
Prof. V.V. Vinogradov	Moscow State Univ., Russia
Prof. A.B. Huang	Nat. Chiao Tung Univ., SEAGS
Prof. Chung Jung Lee	Nat. Central Univ., Taiwan, SEAGS
Dr. Jan Laue	ETH Zurich, Switzerland
Dr. S.W. Jacobsz	Jones & Wagener, South Africa
Dr. Berrak Teymur	Istanbul Technical Univ., Turkey
Dr. Charles Hird	Univ. of Sheffield, UK
Dr. Gopal Madabhushi	Cambridge Univ., UK
Prof. Michael Davies	Univ. of Auckland, NZ
Dr. Andrew McNamara	City University, UK
Prof. Patricia Culligan	Columbia Univ., USA

## 5 COMPLETED AND ON-GOING ACTIVITIES

## 5.1 Committee Meetings

Committee meetings were held in Osaka in 2005 and in Hong Kong in 2006, where action plans were discussed for future TC2 activities. About 20 members attended each meeting and decisions were taken about the formation of three new working groups to contribute ideas on education (Dr. S.P.G. Madabhushi, UK), industry (Dr. C. Gaudin, AUS), and data archiving

and exchange (Dr. Paul Schaminee, NL) in addition to the existing scaling laws project group (led by Dr Jacques Garnier, FRA & Dr Ryan Phillips, CAN) for physical modelling of geotechnical problems. The work of this project group led to publication of the Catalogue of Scaling Laws (Garnier et al., 2007).

TC2 members also gathered for informal discussions at the various regional conferences and events that took place over this period: the Asian Regional Conference in Kolkata in December 2007, at the Eurofuge event in City University, London in May 2008 and the European Regional Conference in Madrid in September 2008. The next TC2 meeting is scheduled for the ISSMGE Conference in Alexandria, Egypt, in October 2009.

## 5.2 TC2 International Conference on Physical Modelling in Geotechnics, July 2006

The highlight of the TC2 events in this quadrennial was the TC2 conference held in Hong Kong, from 4 to 6 August 2006, continuing the theme from earlier centrifuge conferences and workshops, following the 3 original regional symposia held in UK, Japan and US in 1985. The first international conference on Centrifuge Modelling was held in Paris, France, in 1988. Subsequent Centrifuge conferences were held in Boulder, USA, in 1991; Singapore in 1994; and Tokyo, Japan, in 1998.

With the expansion of the TC2 charter to include geotechnical physical modelling, the first conference on Physical Modelling in Geotechnics was held in Canada in 2002. The 2006 conference continued to embrace this widened scope with much success, reflected in the attendance of over 300 delegates.

The conference included 9 keynote lectures and 239 papers were presented. The conference proceedings were published as 2 books with a total of 1600 pages (Ng et al., 2006a&b). These papers represented work from more than 30 countries and every inhabited continent around the world. the keynote presentations were delivered by R.J. Bathurst (reinforced soil walls), Z.Y. Chen (rock slopes), P. Culligan & K. Soga (NAPL behaviour), C. Gaudin (offshore geomechanics), M. Kitazume (embankment stabilisation), B.L. Kutter (dynamics and drainage), C.F. Leung (passive pile response), L. Picarelli (flowslides), K. Sassa (landslides) and M.D. Bolton (seasonal embankment failure).

Some delegates were delayed by the closure of Hong Kong Airport on the conference eve due to a typhoon. However, a full programme went ahead on day one after a small amount of re-shuffling. The dignitaries who presided over the opening of the event are shown 'switching on' the conference in Figure 1.



Figure 1. The opening ceremony of the 6<sup>th</sup> ICPMG

In addition to the plenary and parallel sessions in which the 239 papers were presented, the conference included a session devoted to video presentations of physical modelling events, a tour of the HKUST centrifuge and a banquet in a floating restaurant. The 2005 Schofield Award for the best paper published in the IJPMG was presented during the conference to Dr. Gaudin, Dr. Garnier and Dr Thorel by Prof. Kusakabe (Figure 2).



Figure 2. Presentation of the Schofield Award at the 6<sup>th</sup> ICPMG

### 5.3 TC2 Technical Sessions

TC2 has also organised the following technical sessions, workshops and symposia.

#### a) Panel Discussion Session at VIth ICSMGE, August 2005

A panel discussion session on Modelling was organised by TC2 and TC35 (Microgeomechanics) within the 16th International Conference on Soil Mechanics and Geotechnical Engineering in Osaka, Japan. The session was chaired by Prof. F. Molenkamp and Prof. R. Wan, and the invited speakers included Prof. M. Bolton, Prof. S.M. Springman, Prof. I. Vardoulakis and Prof. R. Charlier. The speakers highlighted the complementary roles of their respective forms of modelling – physical and constitutive – and set challenges to the ‘opposing’ speakers. A lively debate regarding the advantages and disadvantages of different forms of modelling, the use and abuse of numerical analysis and the realism, or otherwise, of small-scale model tests ensued.

#### b) International TC2 Seminars

International Seminars on geotechnical physical modelling were hosted in Bogotá, Colombia at the University de Los Andes by Dr Bernardo Caicedo and in Rio de Janeiro, Brazil by Prof. Márcio Almeida in July 2007.

At each event, Sarah Springman contributed to a full programme of presentations providing an overview of geotechnical physical modelling, centrifuge techniques and the use of these models to advance theory and practice. In Bogotá, the focus was more on education of doctoral researchers and local geotechnical engineers to support the growth of centrifuge modelling in the region, with about 40 attendees. Dr Caicedo presented work on physical modelling of unsaturated soil behaviour. Other speakers were Prof. Marcio Almeida (COPPE-UFRJ), Dr. Carol Murillo (LCPC, Universidad Nacional de Colombia).

The technical programme presented in Rio de Janeiro drew speakers from around Brazil, and was attended by about 70 people. In addition to Prof. Springman, the speakers were Prof. Fernando Schnaid (UFRGS), Prof. Francisco Lopes (COPPE-UFRJ), Dr. José Renato Oliveira (IME), Dr. Gisleine C. Campos (IPT), Prof. Márcio Almeida (COPPE-UFRJ), Prof. Maria Cascão (Poli-UFRJ), Dr. Maurício Ehrlich (COPPE-UFRJ), Prof. Nelson Aoki (USP-S. Carlos), Dr. Paulo Santa Maria (COPPE-UFRJ) and Dr. Ricardo Garske (Petrobras).

#### c) Memorial Symposium, 14<sup>th</sup> European Regional Conference in Madrid, Spain, September 2007

In conjunction with TC23, TC2 supported a pre-conference session to celebrate the outstanding work of Prof Niels Krebs Ovesen at the European Regional Conference in September

2007 in Madrid Spain. Prof. Ovesen’s contribution to physical modelling was recognised with a lecture presentation and publication (Springman, 2008), and the session was attended by members of his family and about 100 participants.

#### d) TC2 Session at 13th Asian Regional Conference in Kolkata, India, December 2007

A Technical Session was organised by TC2 member, Dr B. Viswanatham at the Asian Regional Conference in Kolkata, India in December 2007, which was well attended by almost 100 participants. Prof. Sarah Springman co-chaired the event with Prof. Charles Ng, having visited the Sudarshan Beam Centrifuge at IIT Mumbai en route to Kolkata and given a colloquium.

The theme of the session was “Application of Physical Modelling to Infrastructure Development”. Speakers included ISSMGE Secretary General, Prof. Neil Taylor (Great Britain), Prof. D-S. Kim, (Korea), TC2 Members, Prof. C-J. Lee, (Taiwan), Dr.-Ing. B.V.S. Viswanadham (India) and Prof. Springman (Switzerland). These speakers presented centrifuge model studies on various geotechnical topics related to infrastructure development (Viswanadham, 2007).

#### e) Inaugural European Workshop on Centrifuge Modelling (‘Eurofuge’), May 2008

Dr. Andrew McNamara and colleagues at City University, London, organised the inaugural European Workshop on Centrifuge Modelling, during May 2008, with the support of TC2. This event was an informal two day symposium for practicing geotechnical engineers and researchers. The symposium comprised one day devoted to centrifuge modelling techniques aimed primarily at researchers and one day aimed at industry-academia interaction. The industry day included presentations showcasing innovative model testing conducted for industry applications.

The event was attended by 60 delegates, including representatives from virtually all European centrifuge modelling centres. The opening presentation was given by Prof. Andrew Schofield and the highlight of the final day was a presentation by Dr. Scott Steedman of the centrifuge modelling studies conducted after the levee failures during Hurricane Katrina.

#### f) Centrifuge Modelling Session, 16<sup>th</sup> Int. Conf. on Offshore Mechanics and Arctic Eng. (OMAE), Honolulu, June 2009

A special session dedicated to centrifuge modelling was organised by Prof. White and Dr. Gaudin within the Offshore Geotechnics Symposium of the OMAE conference. A total of 12 centrifuge-related papers were submitted, leading to overflow into other sessions. Representatives from the centrifuge facilities at UWA, Dundee and the NUS made presentations.

#### g) UWA Beam Centrifuge, 20<sup>th</sup> Birthday Celebration

Prof. Sarah Springman prepared a virtual commemorative presentation for the 20<sup>th</sup> birthday celebrations for the beam centrifuge at the Univ. of W. Australia. She paid tribute to the role of this facility in popularising the use of centrifuge modelling within Australia and the Asia-Pacific region, and within the offshore engineering industry, under the direction of Prof. Mark Randolph. Researchers, who cut their teeth on the UWA centrifuge, and experimental techniques that were pioneered in this facility, are now found worldwide: Dr Gaudin being invited to share the UWA expertise at the opening of the KAIST centrifuge in Korea too. The UWA group also hosts the TC2 website.

## 6 INTERNATIONAL JOURNAL OF PHYSICAL MODELLING IN GEOTECHNICS

Many TC2 members are involved in the core editorial group for the International Journal of Physical Modelling in Geotechnics, which has been published since March 2001. TC2 core member Prof Osamu Kusakabe (Japan) is the Editor-in-Chief again after handing over for a 3 year period to Prof. Jiro Takemura (Japan). The journal was hampered by not adopting a streamlined administrative system at the same time as the other mainstream journals, slowing the processing of manuscripts and preventing the journal having a clear 'shop window' of comparative professionalism to other journals. However, the journal remains in strong financial shape and we are currently in the process of finalising a transfer of the journal to Thomas Telford, who will adopt the journal in 2010, providing an administrative platform and marketing of the journal alongside its other geotechnical titles, which include Géotechnique and the ICE Proceedings. The Editorial control of the journal will remain with TC2 members.

## 7 OTHER ACTIVITIES

### a) TC2 web site

Dr C. Gaudin (UWA, Australia) designed and maintained a new TC2 web site that is linked to other sites, including ISSMGE, from 2006. The site ([www.tc2.civil.uwa.edu.au](http://www.tc2.civil.uwa.edu.au)) provides information and news regarding the activities of TC2 and associated events related to geotechnical physical modelling.

## 8 FUTURE ACTIVITIES

### a) Alexandria ISSMGE Conference, October 2009

TC2 members responded positively to the call for participation in technical sessions for the forthcoming ISSMGE Conference in Alexandria, Egypt, to be held in October 2009. A contribution on physical modelling has been made to the general report on 'Soil Behaviour and Testing (Mayne et al., 2009) by Profs. An Bin Huang and Sarah Springman.

### b) TC2 Workshop on Centrifuge Modelling: 'In the light of better centrifuge modelling technology', November 2009

A two-day international workshop will be hosted by Tongji University, Shanghai, during November 2009, organised by Dr Xianfeng Ma. The event will include training and education sessions in addition to research presentations, aimed at supporting the large network of newly established centrifuge facilities throughout China. The international speakers will include Profs. Bolton, Springman, White and Dr. Gaudin.

### c) TC2 International Conference on Physical Modelling in Geotechnics, June 2010

Prof. Sarah Springman will lead the Local Organising Committee (LOC) to deliver the next TC2 conference in Zurich in June 2010, with assistance from TC2 member Dr Jan Laue as Vice Chair. TC2 core members and members are represented on the LOC and the International Advisory Board (IAB) and will be engaged as reviewed editors and reviewers. The second bulletin of the conference has been distributed and e-mailed worldwide, and nearly 400 abstracts have been submitted. A deadline of 10<sup>th</sup> September has been set for submission of the papers. A website has been set-up for the event, including an online review process: <http://www.icpmg2010.ch>.

There will be 4 keynote lectures in Soil Structure Interaction (Prof. R.N. Taylor, UK), Natural Hazards (Prof. M.C.R. Davies, NZ), Earthquake Engineering (Prof. A. Elgamal, USA) and Soft Soil Engineering (Prof. F.H. Lee, Singapore), with subsidiary

general reports to be delivered according to the distribution of papers within these themes. Discussion sessions will be conducted on *Scaling Laws* and *Impact on Industry Practice* as well as a special paper session on *Physical Modelling in Education*.

## 9 SUMMARY OF ACTIVITY

TC2 has continued to be a very active committee between 2006 and 2009. Committee meetings were held, and there has been intensive virtual interaction, with activities developed by smaller groups of members. TC2 has organised several events during this period: a Workshop at the Osaka ISSMGE Conference in September 2005, International Seminars in Bogota and Rio de Janeiro in July 2007, Technical Sessions at the Asian Regional Conference in Kolkata, India in December 2007, the European Regional Conference in conjunction with TC23 to recognise the work of Prof Niels Krebs Ovesen, and the Off-shore, Ocean and Arctic Engineering conference in Honolulu, Hawaii in June 2009. Many TC2 members have acted as editorial members of the International Journal of Physical Modelling in Geotechnics. The Journal remains in strong financial shape and will be transferred to Thomas Telford in 2010.

The highlight of TC2 events is the International Conference on Physical Modelling in Geotechnics, which was held in Hong Kong, in August 2006. The next TC2 conference will be in Zurich in June 2010. Many TC2 members interact with other ISSMGE technical committees and are invited to deliver keynote/invited presentations at major international geotechnical conferences worldwide. Both a Committee Meeting and a Workshop is planned at the forthcoming ISSMGE Conference in Alexandria in October 2009, many TC2 members will play key roles in various technical sessions at the conference.

TC2 is one of the oldest technical committees in ISSMGE. Since its establishment in the early 1980's, it had been very active in promoting geotechnical physical modelling through organisation of major international conferences and workshops. Members have initiated and continue to manage the publication of the International Journal on Physical Modelling in Geotechnics, which will evolve soon through a new publisher and an attempt to become listed as an ISI journal. The current Committee strongly recommends to the next ISSMGE President that TC2 should continue to exist for the promotion of geotechnical physical modelling activities worldwide.

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