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Administrative report: TC3 – Geotechnics of pavements

Compte rendu sur la CT 3 – Géotechnique des chaussées

A. Gomes Correia
University of Minho, Guimarães, Portugal

ABSTRACT

This report gives details of the Technical Committee 3 (TC3), “Geotechnics of Pavements”, covering the activities in the four year period September 2005 – October 2009. It includes: TC composition, terms of reference; activities initiated, activities completed and reported. During this period TC3 has focused on promoting and enhancing professional activities in geotechnical, pavement and rail track engineering in areas related geotechnical aspects in design, construction, maintenance and monitoring.

RÉSUMÉ

Ce rapport présente les détails du Comité Technique 3 (TC3), “Géotechnique des Chaussées” couvrant les activités pendant la période de Septembre 2005 à Octobre 2009. Ceci comprend la composition du Comité, les termes de référence, les activités entreprises, terminées et rapportées. Pendant cette période, le travail du Comité a été de promouvoir et d’augmenter les activités géotechniques liées aux routes et aux chemins de fer dans les domaines du projet, de la construction, de la maintenance et de l’auscultation.

Keywords : geotechnique, pavements

1 INTRODUCTION

The International Technical Committee, TC 3 “Geotechnics of Pavements”, of the International Society for Soil Mechanics and Geotechnical Engineering – ISSMGE, started in 2001 under the proposal of the ISSMGE Board 2001 – 2005. It follows the previous activities of ETC 11 (1997-2001). During all these activities an important dissemination work was done that culminated in four important publications: “Unbound Granular Materials. Laboratory Testing, In Situ Testing and Modelling” (Gomes Correia, 2000), “Compaction of soils and granular materials” (Gomes Correia & Quibel, 2000), “Geotechnics for roads, rail tracks and earth structures” (Gomes Correia & Brandl, 2001) and “Geotechnics in Pavement and Railway Design and Construction” (Gomes Correia & Loizos, 2004).

The major achievements of this term 2005-2009, herewith described, were the following:

- Publication of a book disseminating some of the previous work, mainly the material presented during the Osaka TC3 workshop in connection with the 16th International Conference on Soil Mechanics and Geotechnical Engineering (Gomes Correia, Momoya and Tatsuoka, 2007) The subjects covered deals with: geotechnical aspects related to foundation layers and rail tracks; earth structures in pavement and railway construction – promoting the use of processed materials and continuous compaction control, and strengthening and reinforcement of pavements and rail track.
- Use various conferences and related events to get and provide information concerning TC3 technical matters. In this context a highly successful Workshop was held during the XIV ECSMGE.
- Organisation of the 1st TC3 International Conference series on Transportation Geotechnics.
- Develop activities according the terms of reference for the period 2005-2009.
- Propose future developments.

2 MEMBERS OF TC3

A group of experts were appointed by the chairman as core members (Appendix 1, Table 1). Regular members were based on the candidates recommended by the ISSMGE member Societies (Appendix 1, Table 2). All members are listed in Appendix 1.

3 TERMS OF REFERENCE OF TC3

The goal of TC3 committee (2005-2009) was to promote co-operation and exchange of information and knowledge about the geotechnical aspects in design, construction, maintenance and monitoring of pavements in transportation infrastructure (roads, railways, airports). For these purposes the following topics were established:

1. Design parameters for foundation layers of pavements (roads, railways and airports). Compilation of worldwide information about reliable existing data of modulus and damping. Application of “Artificial Neural Networks” to automate the prediction of design parameters” (Guidelines to take into account the nonlinear material behavior (modulus and damping) into the mechanistic design)
2. Earth structures in pavement and railway construction:
 - a. Compile and homogenize specifications;
 - b. Work at CEN level to standardize the continuous compaction control (following the previous work of TC3 (2001-2005))
3. Subsurface sensing for transportation infrastructure condition diagnostics:
 - a. Synthesize the knowledge about current state of the art techniques (GPR, SASW, IR, etc.) to provide an image of subsurface anomalies and identify internal deterioration as well as prerequisite conditions for further deterioration.

- b. Integrating seismic (SASW) and deflection (FWD) monitoring to evaluate deterioration of pavement or rail track structures (asphalt and geomaterials stiffness degradation).
4. To promote TC3-sponsored sessions on Geotechnics of pavements in transportation infrastructures at ISSMGE-sponsored international and regional conferences on soil mechanics and geotechnical engineering, and to support special geotechnical, geoenvironmental and unsaturated soils conferences on pavements in transportation infrastructures.
5. To cooperate actively with other technical committees whose field of activity involves important questions related to pavements in transportation infrastructures.
- To activate the work in these terms of reference five working groups were set up:
- WP1 - Design parameters for foundation layers of pavements. Co-ordinators: A. Gomes Correia, Portugal; Y. Momoya, Japan; E. Tutumler, USA.
 - WP2 - Earth structures in pavement and railway construction. Chairman: Alain Quibel, France.
 - WP3 - Subsurface sensing for transportation infrastructure condition diagnostics. Chairman: Soheil Nazarian, USA.
 - WP4 - First Conference on “Geotechnics for Pavements in Transportation Infrastructures” (2008). Chairman: Hai Sui Yu, UK.
 - WP5 - Journal on “Geotechnics for Pavements in Transportation Infrastructures”. Chairmen: A. Gomes Correia, Portugal; Hai Sui Yu, UK.

4 TC3 ACTIVITIES DURING 2005-2009

4.1 Participation in related events promoting and disseminating TC3 activities (WP1, 2 and 3)

1st International Seminar on Earthworks in Europe. Palais des Congrès, Paris, 26-27/10/2005.

“Development of modern transportation infrastructure: role of geotechnical engineering”, session 6, part of the XIII Danube European Conference on Geotechnical Engineering, Ljubljana, Slovenia, 29-31/05/2006.

British Geotechnical Association, 2006 Touring Lecture. “Geotechnics for pavements and rail tracks. Innovations in construction and design”, 14 de November in Glasgow (Scottish Geotechnical Group), 15 November in Swansea (South Wales Geotechnical Group) and 16 November in Wokingham (Southern Geotechnical Group, TRL).

International Conference on Railway Management and Engineering at the University of Palermo, Italy, April 1-4/04/2007.

Keynote Lecture at the RailFound 06 - Railway Foundations 2006. Applied research and application to underpin improved railway track design and performance. (G.S. Ghataora & M.P.N. Burrow (eds.)). University of Birmingham Press, Birmingham, 11-13/09/2006.

Theme Lecture at the 3rd International Conference on Site Characterisation. Geotechnical and Geophysical Site Characterization (TC 16). (An-Bin Huang & W. Mayne (eds.)). Taylor & Francis/ Balkema, Leiden, The Netherlands. Taipei, Taiwan, 1-4/04/2008.

Interaction Soil-Railway Track for HST, International Seminar organised by the Portuguese Geotechnical Society, University of Minho, National Laboratory of Civil Engineering, New

University of Lisbon and Technical University of Lisbon - IST, with the sponsorship of RAVE (High Speed Railway Network), REFER (National Railway Network) and the Foundation for Science and Technology, Lisbon, Portugal, 23–24/09/2008.

2nd International Seminar on Earthworks in Europe. Royal Geographical Society, London, UK., 3-4/06/2009.

Eighth International Conference on the Bearing Capacity of Roads, Railways and Airfields. University of Illinois at Urbana-Champaign, 29/06-2/07/2009.

Keynote Lecture at the GeoHunan International Conference “Challenges and Recent Advances in Pavement Technologies and Transportation Geotechnics”, in Hunan, China, 03-06/08/2009.

4.2 TC3 Workshop on Management of Materials for Infrastructures in Urban Environments, Madrid, 23th September 2007.

The intent of this Workshop was to bring together researchers, practitioners, designers and constructors to discuss and to share their experience and to find new challenges for the future on the management of materials for infrastructures in urban environments. The Workshop was organised by A. Gomes Correia (TC3 chair) and local members of CEDEX: Dr. F. Pardo de Santayana and Dr. H. Cano Linares. This was a well attended workshop (30 participants) in connection with the XIV European Conference on Soil Mechanics and Geotechnical Engineering (XIV ECSMGE, 2007). Appendix 2 presents the Workshop contributions by TC3 members and invited speakers.

Two main sections were carried out encouraging speakers/audience interaction under the control of a moderator, highlighting the latest developments in research and practice. The technical themes discussed were:

1. Recycling materials:
 - Non destructive methods.
 - Treatment of geomaterials
 - Impact on environment.
 - Reuse of construction waste materials.
 - New recycling materials.
 - Evaluation and monitoring of construction.
2. Innovations in construction
 - Innovations in equipment.
 - Accelerated construction.
 - Flowable fills.
 - Micro-trenches.
 - Bio materials for construction.
 - Box and pipe jacking.

The President of ISSMGE (2005-2009), Dr. Pedro Sêco e Pinto, joins the Workshop and addressed a message encouraging the TCs to focus on the following topics in the remaining two years:

- Appraise current research and practice.
- Relate to other committees.
- Promote dialogue with practitioners.
- Collate information.
- Disseminate findings.
- Involve industry.

4.3 1st International Conference on Transportation Geotechnics, Nottingham, 25-27 August 2008 (WP4)

The conference was held at the University of Nottingham's Jubilee Campus, UK. The conference, under the umbrella of TC3, was organised by the Nottingham Centre for Geomechanics (NCG) and Nottingham Transportation Engineering Centre (NTEC). The 7th International Symposium of Unbound Aggregates & Roads (UNBAR 7) was included as

a theme in this conference.

University of Nottingham is generally regarded as the home of academic studies in relation to pavement engineering and associated geotechnics in the UK, and as a result it has been selected by TC3 of ISSMGE to host the 1st International Conference on Transportation Geotechnics. Prof. Hai Sui Yu, TC3 core member, was invited to be the chairman of the Organising Committee.

The conference comprised parallel sessions over a 3 day period, including keynote lectures, oral presentations, discussions and posters (Appendix 3). The Sessions were chaired by internationally recognised academics and practitioners.

Professor Mike Jamiolkowski participated in the opening ceremony addressing to the participants the challenge of geotechnics in transportation infrastructures.

Specific themes presented and discussed during the conference were:

- Unbound aggregates (UNBAR 7).
- Slope instability, stabilisation, and asset management.
- Construction on soft ground.
- Interaction with structures and geogrid reinforced soil.
- Effects of climate change and vegetation.
- Highways, pavements and subgrade.
- Railway geotechnics.
- Soil improvement.

The conference offered five keynote lectures on the following topics (Ellis et al., 2008):

- "The Role of Soil Viscosity on the Behaviour of Reinforced Embankments", by Professor Kerry Rowe;
- "Recent Research on Railway Track Sub-base Behaviour", by Professor William Powrie;
- "Applications of Reinforced Soil for Transport Infrastructure" Professor Alan McGown and Professor Stephen Brown;
- "Unified Constitutive Modelling for Pavement Materials with Emphasis on Creep, Rate and Interface Behavior", by Professor Chandra Desai;
- "Innovations in Design and Construction of Granular Pavements and Railways", by Professor A. Gomes Correia.

Prominent members of TC3 gave important oral presentations and made contributions to the proceedings. Over 140 participants from 26 countries registered to this important Conference, and the proceedings contain 100 reviewed papers. The proceedings of this conference is available from CRC Press Taylors & Francis/ A Balkema (Ellis et al., 2008).

4.4 Committee Meetings

During the current term of the Committee (2005-2009) three formal meetings were held:

- TC3 meeting, Nottingham, 21st November 2006 (11h00-17h00) at University of Nottingham, Nottingham Centre for Geomechanics.
- TC3 meeting, Madrid, 24th September 2007 (12h30-14h00) at Palacio de Congresos y Exposiciones de Madrid, room 29, in connection with TC3 workshop and the XIV European Conference on Soil Mechanics and Geotechnical Engineering.
- TC3 meeting, Nottingham, 26th (17-18h15); 27th (13h20-13h40) August 2008 at University of Nottingham, New Business Center, room A07, in connection with the 1st TC3 International Conference.

4.5 Website

The TC3 uses a website that allowed the dissemination of information, events announcements and email correspondence between its members. It is currently located at: www.webforum.com/tc3/home/index.asp?sid=598&mid=1

4.6 WP Summary

The tasks of the Committee (WP) were largely met; in particular WP2 and WP4 were very successful and completely accomplished. An important work has been realized by Dr. Alain Quibel promoting liaison at CEN level to standardize continuous compaction control. In fact, he put a great effort in European works to clarify the functionalities of the equipments proposed for intelligent compaction. The players involved in the project are: the ISSMGE TC3 committee (represented by Dr. Alain Quibel), who request the need of clarification; the "Road Equipment Committee" of the CFTR (French committee for road techniques), composed of manufacturers, contractors and administration members, who pointed out the intelligent compaction as a task; the CISMA (Trade association of manufacturers and suppliers for the construction, infrastructure, steel, and material handling), who attends the CFTR road equipment committee meetings; and the CECE (Committee for European construction equipment). The secretary of section I, for road equipment, is at the moment handled by CISMA general secretary. At this stage an agreement was attained between the main manufacturers concerning a global approach for the description, in a harmonized way, of the main functions of their devices for intelligent compaction. This work should continue and will be in the future the main framework to implement worldwide the compaction management (more appropriate term than intelligent compaction).

The 1st International Conference on Transportation Geotechnics (the 1st of the series to be organized by TC3 members) organized by Prof. Hai Sui Yu and his colleagues at the University of Nottingham was very successfully and entirely accomplished (WP4). It should be stressed the important interaction observed during this Conference between geotechnical and pavement engineers, academics and researchers, which is one of the aims of the TC3 Committee.

The works of WP1 and WP3 were largely disseminated in the events organized by the Committee and in the related Conferences.

The Journal on "Geotechnics for Pavements in Transportation Infrastructures" (WP5) is still in negotiation with a publisher and will be very soon a quarterly journal of the Committee. The aim is to publish high quality, theoretical and applied papers on all aspects of geotechnics for roads, highways, railways, airfields and waterways.

5 FUTURE ACTIVITIES

2nd TC3 International Conference on Transportation Geotechnics, will be organised by the TC3 Japanese domestic committee under the umbrella of the Japanese Geotechnical Society (Chairman is Professor N. Yoshida and Dr. Momoya is secretary). The Conference will be held in Hokkaido University Conference Hall, Sapporo, Japan. It is planned that this conference will have more interaction with the IAGE, ISRM, IGS and the TC of ISSMGE in the related matters (Environment, non-saturated soils, frost).

Another important output will be the Journal of the Committee on "Geotechnics for Pavements in Transportation Infrastructures".

Other activities and possible revision to the Committee's terms of reference may be decided by the incoming Committee and its chairman.

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APPENDIX 1 : TC3 Committee Members

Table 1. Core Members of TC3 during 2005-2009.

| Name | Country |
|--------------------------|----------------|
| A. Gomes Correia (Chair) | Portugal |
| Dietmar Adam | Austria |
| Alain Quibel | France |
| Andreas Loizos | Greece |
| Yoshitsugu Momoya | Japan |
| Hai Sui Yu | United Kingdom |
| Marc Raithel | Germany |
| Soheil Nazarian | USA |
| Tuncer Edil | USA |

Table 2. Regular Members of TC3 during 2005-2009.

| Name | Country |
|-----------------------|----------------|
| F. Cenalía | Albania |
| D. McInnes | Australia |
| J.-C. Verbrugge | Belgium |
| B. Dethy | Belgium |
| L. Goretti Mota | Brazil |
| D. Stolle | Canada |
| L. Tao | China |
| H. Rathmayer | Finland |
| P. Kolisoja | Finland |
| J.-C. Auriol | France |
| Y. Guerpillon | France |
| T. Boromisza | Hungary |
| M. Kovács | Hungary |
| GV Rao | India |
| M. Latifi | Iran |
| E. Farrell | Ireland |
| Y. Takeuchi | Japan |
| B. Teltaev | Kazakhstan |
| S. Wan Park | Korea |
| Y. A. Jimoh | Nigeria |
| L. Rafalski | Poland |
| J. Mateus da Silva | Portugal |
| E. Fortunato | Portugal |
| V. Kazarnovsky | Russia |
| E. Scherbina | Russia |
| A. Parrock | South Africa |
| J. García de la Oliva | Spain |
| J. Neji | Tunisia |
| A. Senol | Turkey |
| M. Winter | United Kingdom |
| E. Tumtuluer | USA |

APPENDIX 2: TC3 Workshop Contributions on Management of Materials for Infrastructures in Urban Environments, Madrid, 23th September 2007.

- Opening remarks, A. Gomes Correia (TC3 chairman, Portugal); Fernando P. de Santayana (Organising committee, Spain);
- Road foundation construction using lightweight tyre bales, M. G. Winter (UK);
- Dealing with marginal soils in earthworks. Some Spanish experiences, Davor Simic (Spain);
- Soil lime treatment: a way to long-term performance, B. Dethy (Belgium);
- State of recycled materials research in the USA, Tuncer B. Edil (USA), presented in video;
- Nondestructive testing for evaluation and monitoring of geomaterials during construction, Soheil Nazarian (USA);
- Burial of fibre optic in urban environment: Cleanfast ©process, B. Moisson (France);
- Autocompacting material in trenches, A. Quibel (France);
- Roadbed and subgrade structures to reduce the track irregularity at structural transition section, Yoshitsugu Momoya (Japan);
- Large size jacked boxes at the Chamartin Railway station, A. Becerril (Spain);
- Final remarks, A. Gomes Correia (TC3 chairman, Portugal).

APPENDIX 3: Program of the 1st International Conference on Transportation Geotechnics, Nottingham, 25-27 August 2008

Monday 25 August

- Welcome & introduction to the conference (Professors Hai-Sui Yu, Mike Jamiolkowski and A. Gomes Correia)
- Keynote 1 – Professor A. Gomes Correia
- Session 1A – Design & Performance of Unbound Pavement Layers – UNBAR theme
- Session 2A – Slope Instability, Stabilisation and Asset Management
- Session 1B – Rutting of Unbound Aggregate Material – Behaviour & Causes – UNBAR theme.
- Session 2B – Construction on Soft Ground
- Session 3 – Highway Geotechnics.
- Session 4 – Soil Improvement.

Tuesday 26 August

- Keynote 2 – Professor Kerry Rowe
- Keynote 3 – Professor Alan McGown and Professor Steve Brown
- Session 1C – Granular Material Alternatives – UNBAR theme.
- Session 2C – Interaction with Structures & Geogrid Reinforced Soil.
- Session 1D – Resilient Behaviour of Granular Material & In-situ Testing – UNBAR theme.
- Session 2D – Effect of Climate Change and Vegetation.
- Session 5 – Rail Geotechnics.
- Session 6 – Characterisation and Recycling of Geomaterials.

Wednesday 27 August

- Session 7 – Slope instability, stabilisation and construction on soft ground additional presentations.
- Session 8 – Rail and geomaterials additional presentations.
- Keynote 4 – Professor William Powrie
- Keynote 5 – Professor Chandra Desai.
- Conclusion (Mr Andrew Dawson).