

New techniques and applications of physical modelling in geotechnics” at the ECSMGE 2019

The international geotechnical community descended on Reykjavik, Iceland for the XVII European Conference on Soil Mechanics and Geotechnical Engineering (ECSMGE) from 1st - 6th September 2019. This provided the perfect backdrop for the ISSMGE TC104: Physical Modelling in Geotechnics to get together. A dedicated workshop “*New techniques and applications of physical modelling in geotechnics*” allowed for dissemination of news, updates and a series of invited talks about recent advances in our field. Approximately 20 delegates attended the workshop ranging from TC regional representatives and some new faces to our community. It was also great to welcome Prof Neil Taylor, our 4th Schofield Lecturer and ISSMGE Secretary General to the workshop.

TC updates and technical presentation reported are summarized below.

TC news:

- (i) **Facility database:** TC members were encouraged to check that their research institutions and facilities were uploaded to the TC database available. Prof. Ma is coordinating the update and can be contacted by email (xf.ma@tongji.edu.cn) to update your information.
- (ii) **Future events:** Updates on the forthcoming European and Asian Conferences on Physical modelling, “Eurofuge” and “Asiafuge” to be held 2020 were provided with Jan Laue, Chair of the 4th Eurofuge conference providing a latest update on this event planning. Details are provided below.
- (iii) **Twitter feed:** a community twitter feed [@tc104pmg](https://twitter.com/tc104pmg) has been setup and it is a great way to keep in contact and build our community by sharing updates of what tests have been conducted in your center. Do check it out and let everyone know what you are up to!

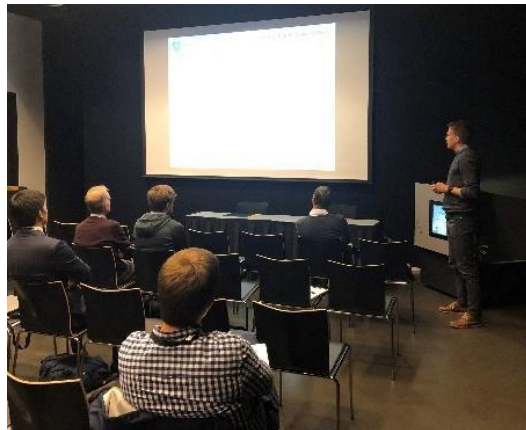
A number of presentations were provided across a diverse range of topics and are summarized below.

Jan Laue provide an update on the planning and preparations for the 4th European Conference on Physical modelling in Geotechnics due to be held in Lulea University of Technology, Sweden in 2020. The proposed conference dates are 18-20 March. Jan reported that the abstract submission is now open until 15th October 2019, with full papers due by 31st December. A conference website has been setup www.ltu.se/ecpmg that provides details of the submission process, travel/accommodation information and the initial outline programme. Similar to previous events Jan is planning a range of keynote speakers, panel and poster sessions. A special session on Hydropower and Mining related issues will also take place. The local organising team are planning a social programme that includes an icebreaker reception, conference dinner with an optional post-conference visit to the renowned Ice Hotel, Kiruna, Storforsen. There is still plenty of time to get those abstracts in!

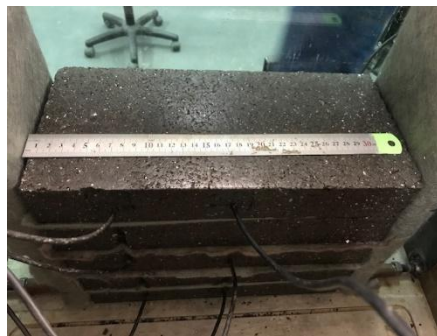
Jonathan Black (University of Sheffield) & Steven Bayton (University of Sheffield & NGI) provided an update on the round-robin bench mark testing on monopiles “Benchmark centrifuge tests for



monopile design". The consortium of researchers, under the leadership of Rasmus Klinkvort (NGI), has expended to 11 institutions including Western Australia, Sheffield, NGI, TU Denmark, Cambridge, IFSTTAR, TU Delft, KAIST, Zhejiang, Nottingham and COPPE. Work has included (i) evaluation of sand properties, (ii) comparative studies of the same prototype at each institution and (iii) test to evaluate the importance of soil density, embedment length and installation effects. It is hoped that this will lead to increased understanding of monopile testing and to encourage greater industry engagement. A journal paper is in preparation. Britta Briennen (Western Australia) will provide a similar update at the Asian Conferences on Physical modelling being held in Singapore in 2020. For further information or to join



the group contact Rasmus on rasmus.klinkvort@ngi.no



Schalk Jacobsz (University of Pretoria) reported on "**Centrifuge modelling of pile pull-out tests in expansive soil**" with the application relating to wind turbine bases on expansive soils. Key

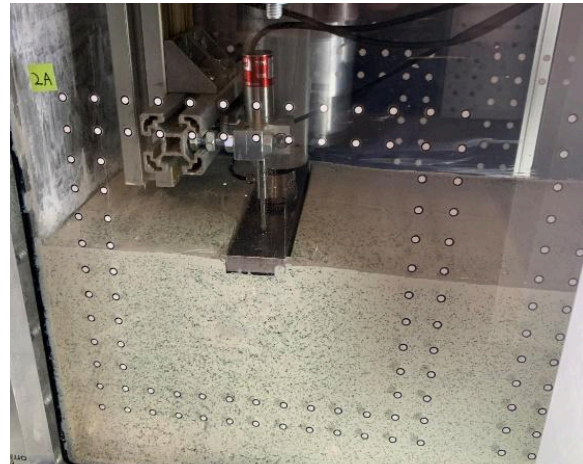
questions posed where "*does clay expansion increase or decrease pile pullout resistance?*" The modelling challenge described focused on the development of a soil that would exhibit suitable swelling within the typical time frame of a centrifuge test. Reconstituted consolidated samples did not reproduce suitable soil swelling behaviour due to low water ingress and penetration through the soil. The team produced a restructured soil adopting a novel approach of segmenting a consolidated block using a cheese grater followed by recompression to create a more open structure. This has proved highly successful and is allowing new insight into the pull out capacity of piles.



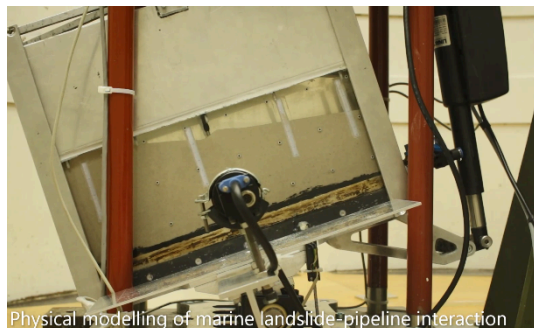
Matthieu Blanc (IFSTTAR) continued the theme of monopiles but focused on the aspect of instrumentation and specifically the use of optic fibre technology – Fibre Bragg Gratings; presenting "**Centrifuge test on instrumented FBGs monopile foundation in sand**". Following a comprehensive overview of FBG technology, the challenges of their installation was discussed and an example application of a monopile presented. This presentation and a later one (by Charles Heron of the University of Nottingham) sparked interesting debate as to the use of FBG's in our model tests and aspects surrounding the affordability/access of this highly desirable technology. It was reported that large variations in price are being paid by centres from different suppliers for both the interrogator units and the FBG manufacturing.

Collectively Matthieu and Charles suggested a future FBG workshop would be useful for further discussion and sharing of experience to encourage greater uptake of this technology.

Jared Charles (University of Sheffield) presented on the derivation of soil stress-strain characteristics using image data with a presentation entitled “**Automated reconstruction of soil stress-strain response from full field displacement measurements and loading data using optimisation**”. This method uses conservation of energy principles such that external work done by an applied loading equates to the internal work done by deformation with in soil. The work equilibrium equation was defined in terms of mean stress, deviator stress, volumetric strain and peak strain. An overview of the method was described and several challenges reported. The method was proven for a simulated retaining wall boundary value problem in FEA with experimental data for an undrained footing in clay. Good correlation was observed with peak undrained shear strength, although some additional optimisation is needed to match the stiffness response.



Weiyuan Zhang (TU Delft) presented “**A novel technique for simulating submarine landslides in a geo-centrifuge**”. This work involved an interesting preparation methodology using fluidisation (with oil) to create sand beds of uniform consistency at 1g. CT scanning was conducted to evaluate the relative density of the fluidised models in three dimensions in order to assess the suitability of the method to produce uniform soil properties. An inflight tilting table was used to activate and initiate a landslide in-flight and propagation of the flow was reported. The impact of landslides on a buried pipe was considered in conjunction with variation in flow rate around the pipe inclusion. This presentation



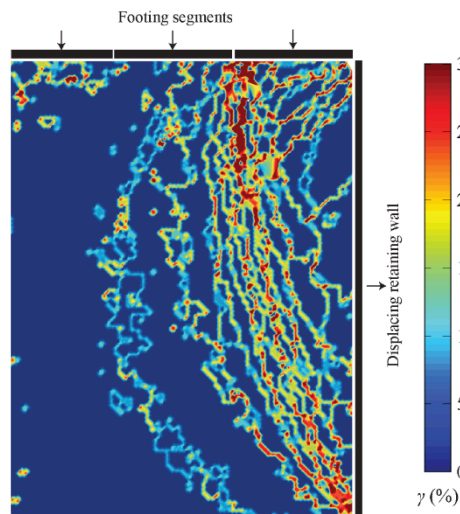
Physical modelling of marine landslide-pipeline interaction

generated discussion as to how terminologies can be easily interchanged by others and perhaps inappropriately misused; for example how fluidised can be referred to static liquefaction, which can present difficulties when communicating with clients or the general public. Weiyuan will be finishing up his PhD in the coming months and will be looking for Post-doctoral or academic position, so if your centre has any vacancies on the horizon get in touch with him on W.Zhang-3@tudelft.nl !

Charles Heron (University of Nottingham) presented on “**Advanced hybrid centrifuge testing for soil-structure interaction problems**”. The concept of hybrid modelling was introduced and how this could advance our traditional approaches of modelling soil-structure interaction discussed. The technique signals the use of centrifuge testing coupled with numerical simulation to update the experimental model in real-time. A tunnel example was presented whereby individual pile loads were adjusted in-flight informed by structural load redistribution determined in the parallel numerical model, updating the pile loads to reflect the new structural conditions. Key aspects about the technology, interfacing of software were discussed. Fibre optics also captured the load



distribution along the piles which contributed to the overall discussions in this area more widely and the need for a TC event to share experiences.



enhance precision.

Sam Stanier (University of Cambridge) provided an overview of the new GeoPIV-RG DIC programme “Freeware PIV/DIC for geotechnical modelling: new advances and applications using GeoPIV-RG”. An overview of the origins of DIC/PIV measurement in soils using GeoPIV was provided. The motivation for GeoPIV-RG was introduced through an example posed by Prof. Muir Wood whereby derived shear strain fields indicated the occurrence of ‘peak locking’ cause by sub-pixel refinement breakdown. Sam demonstrated this by a worked example and provided a summary of best practice and key aspects to check the output and interpretation of strains. Other benchmarking was provided to demonstrate the improvements now available within GeoPIV-RG to

Overall the event was a great success and we wish to thanks the speakers and delegates that attended. As part of the wider conference program there were several additional session on physical modelling. Some excellent work was presented and the papers can be accessed via the main XVII ECSMGE webpage www.ecsmge-2019.com. We look forward to meeting again in Lulea University of Technology, Sweden in 2020.