TC304-TC309 Student Contest on Machine Learning

(APSSRA2020, Toyko, Japan)

The task of this contest is to harness the capabilities of machine learning methods to aid the predictions of soil response under loading of an embankment. The problem geometry is established based on a full-scale trial embankment constructed during 2013, at Australia's first National Field Testing Facility (NFTF) at Ballina, New South Wales, Australia (Sloan and Kelly, 2018). Fig. 1 shows the geometry of the cross-section of an embankment (revised based on the Ballina embankment), which was constructed on layers of soft silty and clayey soils, installed with different types of instrumentation including settlement plates (SP2, SP3), hydrostatic profile gauge (HPG1), magnetic extensometers (Mex1), inclinometers and vibrating wire piezometers (VWP1, VWP2, VWP6). Fig. 1 also shows the locations of the instruments along one of the cross-sections. Information on the construction sequence of the embankment can be found in Fig. 2, which is extracted from Kelly et al. (2018). Deformations and pore water pressures had been recorded at the site for around 3 years, starting from August 2013 (commencement of embankment construction).

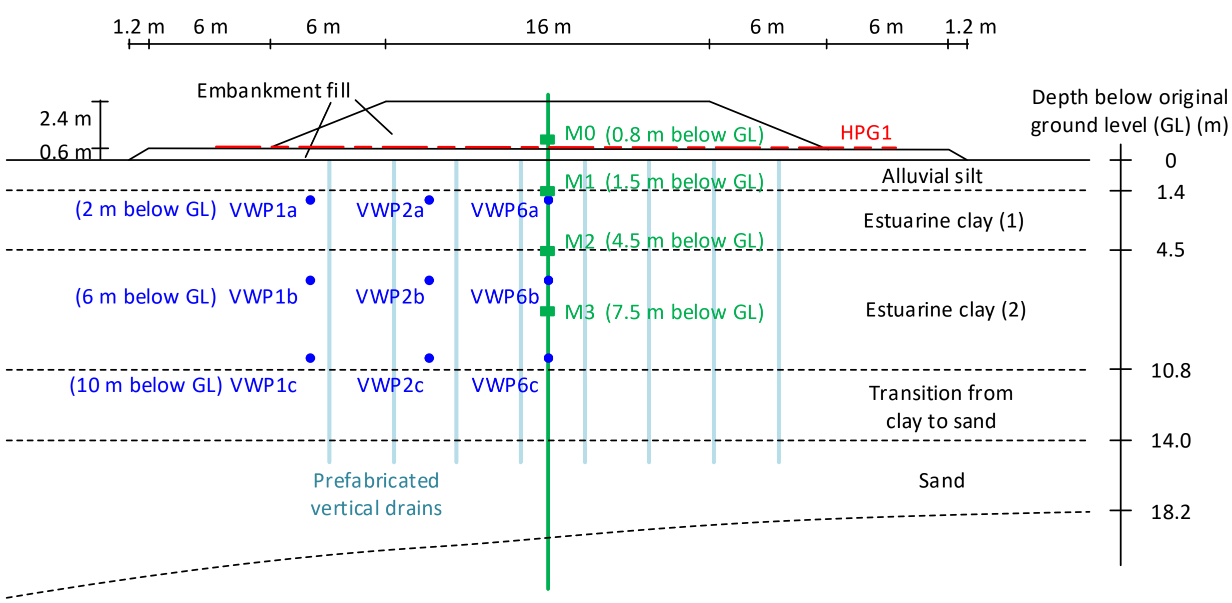

Fig. 1 Cross-section of embankment with locations of instrumentation
(revised based on Kelly et al. 2018)

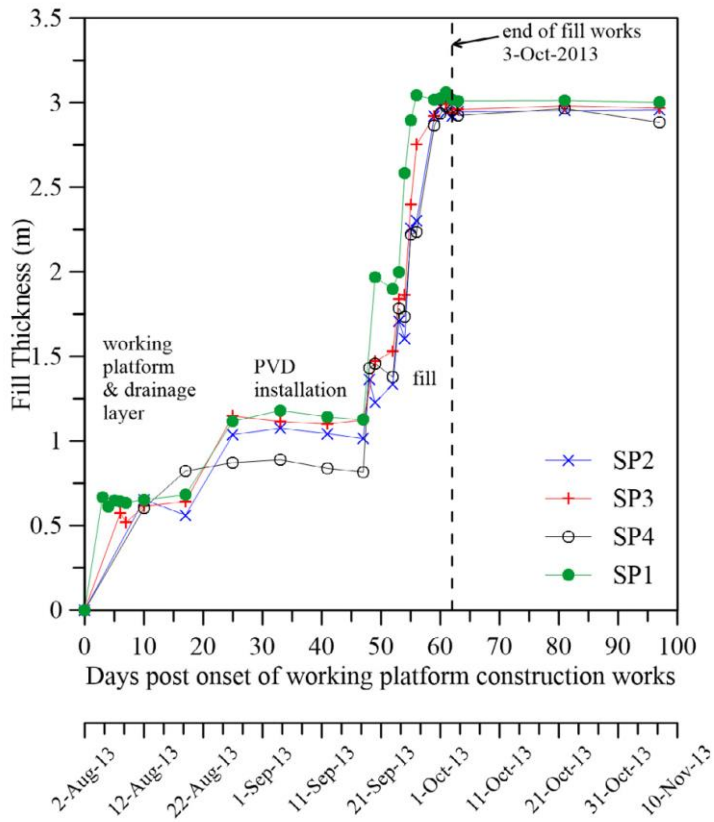

Fig 2 Time history of embankment construction (extracted from Kelly et al., 2018)

The aim of this task is not to conduct back analyses using those reported real measurements. Instead, based on the same geometry and *similar* problem conditions, a synthetic 'benchmark' numerical model has been created to generate 'pseudo' measurement data, including soil displacements and pore water pressure response, at the measurement locations. Apart from the problem geometry, construction sequence and soil strata as shown herein, other modelling details for this benchmark simulation (soil parameters, stress-strain constitutive law) will not be revealed (except that the unit weight of embankment fill can be assumed to be 20 kN/m^3). Synthetic benchmark data on displacements and pore water pressures are provided up to June 2014, through Figs. 3-5 and the enclosed spreadsheets.

The task of this contest is to develop an algorithm to facilitate the prediction of future displacement response (after June 2014) at the same settlement measurement locations (M0 to M3; HPG1) on June 1, 2015 and June 1, 2016. The presented data of pore water pressures can be considered (Fig. 5), but it is not necessary to predict future water pressure response.

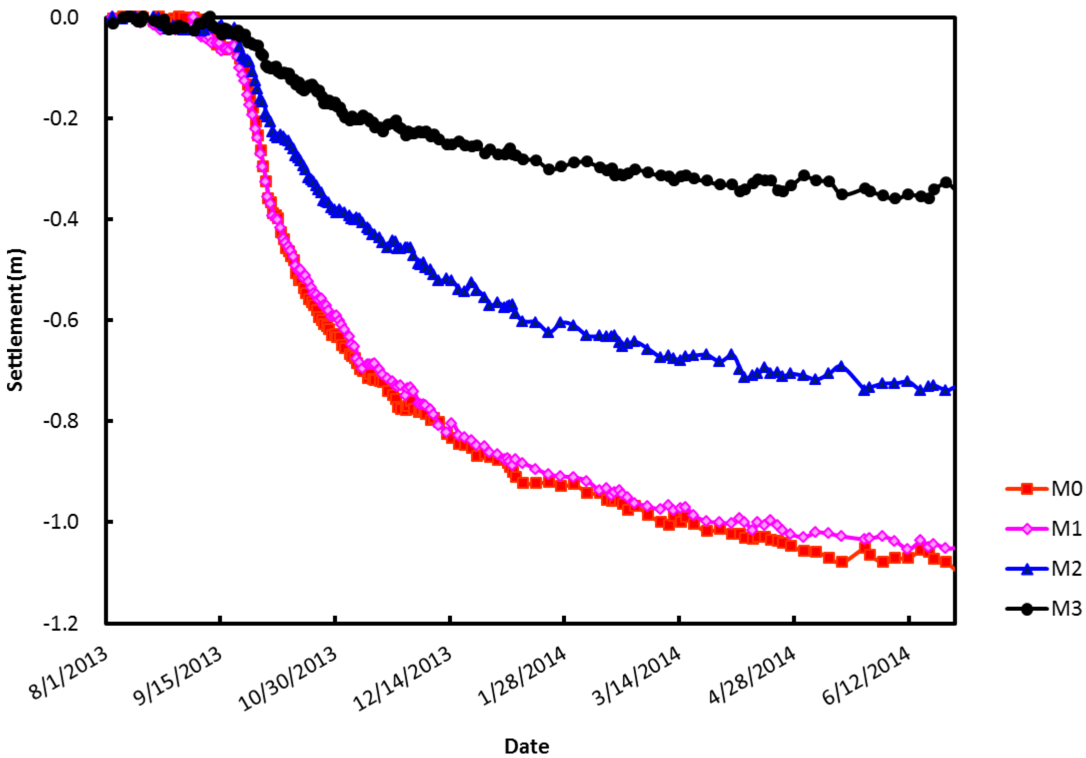

Fig 3 Settlement data by extensometer measurements

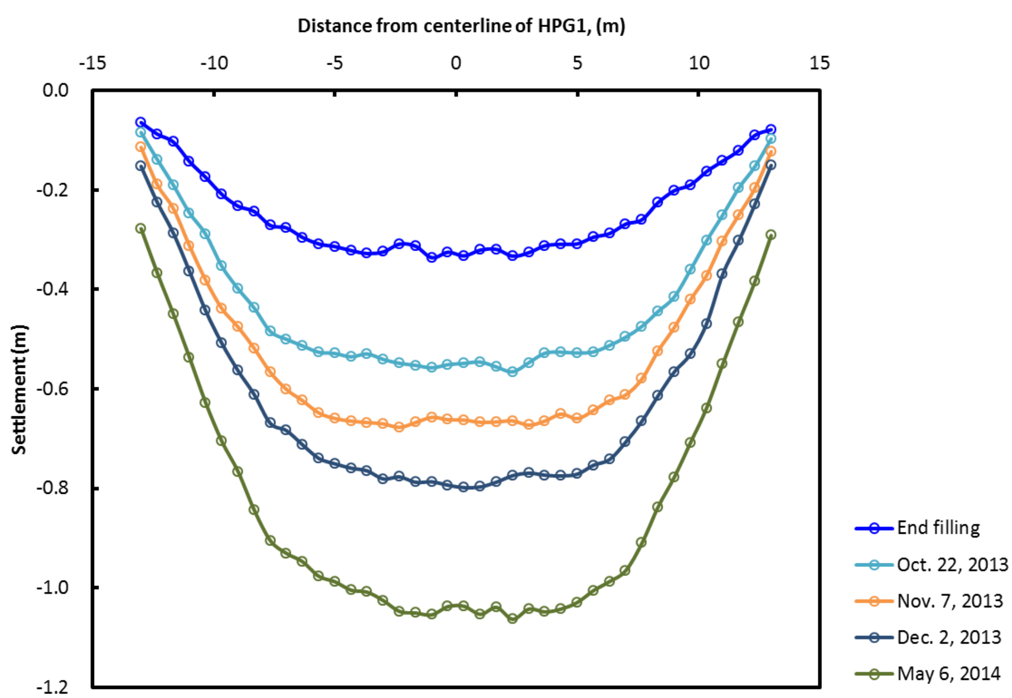

Fig. 4 HPG1 settlement profile across the embankment cross-section

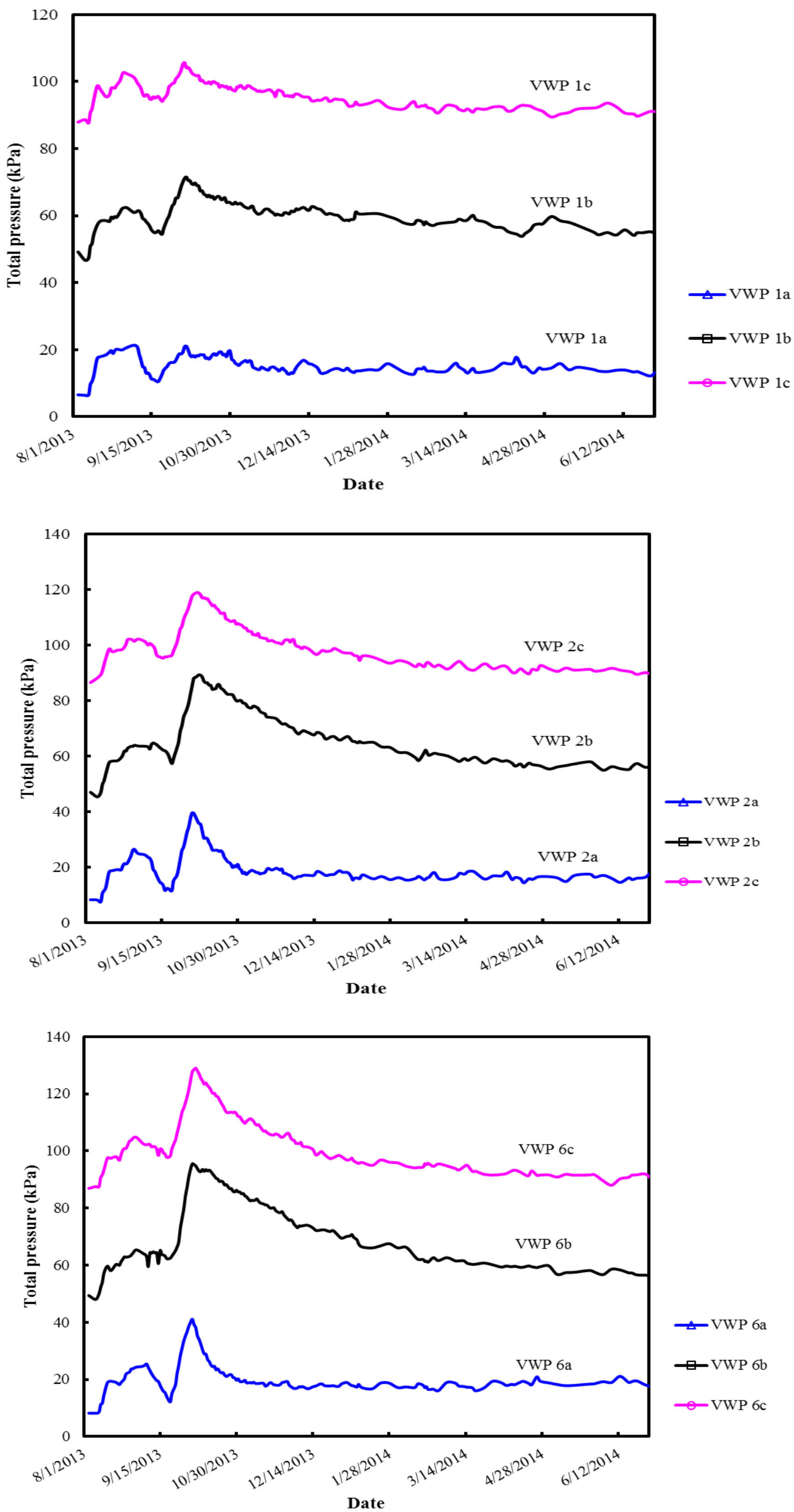

Fig. 5 Pore water pressure data

The main purpose of the algorithm is to reasonably predict the displacement response of the embankment at the subsequent stages. The proposed approach can be solely based on data analytics methods (e.g., statistics, probability, machine learning), or may combine data analytics with soil mechanics principles and geotechnical modelling techniques (e.g. finite element method). However, participants should note that the purpose of this contest is NOT to develop a new soil constitutive relationship or new theories in geomechanics to match the data. The focus should be placed on innovation in data analytics/machine learning approaches and their applications to geotechnical problems.

The participants are encouraged to read the following references to understand the background of the project, the geometry of the embankment and the instrumentation setup. However, it is important to note that the synthetic data (Figs. 3-5) in this contest is intentionally made different from actual measurements at the Ballina site. In other words, the soil constitutive model and soil parameters used to create the benchmark values are also different from those presented in the associated papers. Participants may also consider the possible existence of measurement errors in the presented data, which is common in real site data.

Other information

The participants in the TC304-TC309 Student Contest session are required to: (1) Submit an extended abstract in English to Prof. Takayuki Shuku (shuku@cc.okayama-u.ac.jp), which should include 2 pages of text, in addition to figures and tables, by the deadline of 4 September 2020. Academic staff (e.g., professors) cannot be listed as co-authors, although they can be mentioned in acknowledgements; and (2) present the research findings during the session (10 minutes presentation).

A TC304-TC309 award committee will review the extended abstracts/presentations and select the winner of the ISSMGE TC304-TC309 Student Contest Award. An award certificate will be given to the winner during the conference. Depending on the number of participants, several encouragement awards may be given as well.

References

Doherty JP, Gouvernec S, Gaone F, Pineda JA, Kelly RB, Cassidy MJ, et al. A novel web based application for storing, managing and sharing geotechnical data, illustrated using the National Soft Soil Field Testing Facility in Ballina, Australia. Comput Geotech 2018; 93:3–8.

Jostad HP, Palmieri F, Andresen L, Boylan N. Numerical prediction and back-calculation of time-dependent behaviour of Ballina test embankment. Comput Geotech 2018;93:123–132.

Kelly RB, Sloan SW, Pineda JA, Kouretzis G, Huang J. Outcomes of the Newcastle symposium for the prediction of embankment behaviour on soft soil. Comput Geotech 2018;93:9–41.

Sloan, SW, and Kelly, RB. Newcastle symposium for the prediction of embankment behaviour on soft soil. Comput Geotech, 2018; 93, 1-2.