Cite this article
Castellanza R (2021)
Editorial.
Proceedings of the Institution of Civil Engineers – Geotechnical Engineering **174(3)**: 239–240,
https://doi.org/10.1680/jgeen.2021.174.3.239

Editorial

Geotechnical Engineering

ice Publishing

Editorial

Riccardo Castellanza PhD
Associate Professor in Geotechnical Engineering, University of Milano Bicocca, Department of Earth and Environmental Science, Milan, Italy

When I was invited to write an editorial, my first thought was about my job and the work of the authors: what really is our job? How can we produce feasible predictions? Which is the most appropriate approach? Especially, why do I like my job, geotechnical engineering?

Many answers are possible, starting from my personal experience: when I met my magister, Professor Roberto Nova, he fully fascinated me with this science that combines sophisticated theories and plenty of practical problems to be solved. I spent my first years researching complex hydro-chemo-mechanical processes adopting three pillars: experimental, theoretical, numerical study. It was a very deep research of fundamentals; but I was suffering not to see practical implications. Then, after some years, I found a large number of practical applications. I learnt a universal method which could be applied to any kind of problem, from the smallest and simplest to the largest and most complex.

I like my job because of this permanent link between reality and theoretical model. In order to face a geotechnical problem we are obliged to start from reality, to fix the few controlling variables, to set up theoretical and numerical models and to provide feasible predictions; and then to go back to reality by constructing and monitoring.

I was trained by my teachers on the key features of our job. When we teach, when we research and when we solve practical problems, I think that the following special teachings are in our backpack.

- How to observe reality? 'Reason is like an eye staring at reality, greedily taking it in, recording its connections and implications, penetrating reality, moving from one thing to another, yet conserving all of them in memory, trying to embrace everything. A human being faces reality using reason. *Reason is what makes us human*' (Giussani, 1997: p. xv).
- How to do predictions? 'Aristotle said – any prediction is based either on a rational calculation or on intuitive perception. Although the latter has been for a long time the starting-point of any construction and still plays a relevant role in design, it is the former that allows the definition of the structure's dimensions and safety assessment. In fact, it allows rational prediction of the structure's behaviour in the different construction phases and during its life' (Nova, 2012: p. ix).
- How to do modelling? 'Modelling forms an implicit part of all engineering design, but many engineers engage in modelling without consciously considering the nature, validity and consequences of the supporting assumptions. Many engineers make use of numerical modelling but may not have stopped to think about the approximations and assumptions that are implicit in that modelling – still less about the nature of the constitutive models that may have been invoked' (Muir Wood, 2004: p. ix).

The traces of these 'pillars' are extremely clear in all of the following papers, even with different subjects.

Xu *et al*. (2021) start from a complex real problem: cumulative erosion for suffusion in soils; they arrive at a mathematical model based on key variables and parameters and then go back to reality ensuring that the model is well capable to simulate experimental data. The real process is quite complex but the proposed approach quite simple.

Zhuang *et al*. (2021) move from a practical problem, reinforcement of instable slope in an anisotropic rock: this complex problem is condensed into a 'simple' analytical model, very direct to be used and well validated using numerical modelling. Validating an analytical model on three-dimensional numerical analyses could be considered the closest approximation to real phenomena.

Baziar *et al*. (2021) propose an opposite path: a lesson learnt by the collapse of a deep excavation. The project was well posed, according to standard design codes, but reality was more complex. A 'near-surface zone of weaker fill material was responsible for the failure' (Baziar *et al*., 2021: p. 263). To confirm this assumption, numerical finite-element method (FEM) models were created; the authors show how the model can explain, simulate and predict the real observed behaviour.

Sarkar and Pareek (2021) start from a complex problem: the influence of stratification on dynamic behaviour of deep tunnels. They were able to exploit a suitable numerical approach (the discrete-element method (DEM)) to provide a practical curve to directly evaluate the influence of stratification on dynamic behaviour in a deep tunnel with direct inputs.

The results in terms of 'fragility curves may be used for understanding the response of a tunnel structure … to seismic events, risk assessment and risk management' (Sarkar and Pareek, 2021: p. 289).

Chhun *et al*. (2021) introduce another crucial aspect, still neglected in models: the uncertainty. Here the real problem refers to failure in a slope reinforced with soil nails. A simple modelling is here enriched considering random soil parameters and a Monte Carlo simulation varying nail spacing and inclination, layer thickness and slope angle. The variability of soil parameters is 'normal' in a real slope so that a probabilistic analysis could better reflect the real behaviour. The advantages of considering the probability of failure in the model practically means to 'achieve safe design and effective and economic results' (Chhun *et al*., 2021: p. 300).

Pulatsu *et al*. (2021) propose an approach suggested by reality. They face the stability of masonry retaining walls; observing real case studies of partial collapse, the walls can be well described by DEM, while backfill soil is simulated as a continuum with FEM. The proposed mixed discrete–continuum approach could appear numerically complex, but, if compared and validated on real test sites and case studies, it could be efficiently used to determine any interventions and repairs.

Du *et al*. (2021) follow an 'intuitive perception approach' applied to optimise the design of the foundations for large oil tanks. Three different methods were adopted in a huge field test, in terms of space and time. A full-scale comparative evaluation between dynamic compaction, dynamic replacement with gravel piles and cement fly-ash gravel piles was successfully performed. They experimentally certified that the ground improvement technique could be adopted as a tank foundation and be highly cost-effective. Now, let's apply on it theoretical and numerical models!

In conclusion, geotechnical engineering: a science/art devoted to solving problems, merging experiences and a rigorous scientific method.

REFERENCES

Baziar MH, Ghadamgahi A and Brennan AJ (2021) Numerical analysis of collapse in a deep excavation supported by ground anchors. *Proceedings of the Institution of Civil Engineers – Geotechnical Engineering* **174(3)**: 263–278, https://doi.org/10.1680/jgeen.19.00122.

Chhun KT, Jang HI and Yune CY (2021) Probabilistic analysis of local instability between soil nails. *Proceedings of the Institution of Civil Engineers – Geotechnical Engineering* **174(3)**: 291–301, https://doi.org/10.1680/jgeen.19.00223.

Du FL, Lu SF, Liu JB *et al*. (2021) Field test of composite ground improved by different methods in red soil areas of China. *Proceedings of the Institution of Civil Engineers – Geotechnical Engineering* **174(3)**: 315–330, https://doi.org/10.1680/jgeen.19.00269.

Giussani L (1997) *The Religious Sense*. McGill-Queen's University Press, Montreal, Canada.

Muir Wood D (2004) *Geotechnical Modelling*. Taylor & Francis, Abingdon, UK.

Nova R (2012) *Soil Mechanics*. ISTE Ltd, London, UK and John Wiley & Sons, Hoboken, NJ, USA.

Sarkar R and Pareek K (2021) Influence of stratification and assessment of fragility curves for mountain tunnels. *Proceedings of the Institution of Civil Engineers – Geotechnical Engineering* **174(3)**: 279–290, https://doi.org/10.1680/jgeen.19.00134.

Pulatsu B, Kim S, Erdogmus E and Lourenço PB (2021) Advanced analysis of masonry retaining walls using mixed discrete–continuum approach. *Proceedings of the Institution of Civil Engineers – Geotechnical Engineering* **174(3)**: 302–314, https://doi.org/10.1680/jgeen.19.00225.

Xu Z, Lin P, Xing H and Wang J (2021) Mathematical modelling of cumulative erosion ratio for suffusion in soils. *Proceedings of the Institution of Civil Engineers – Geotechnical Engineering* **174(3)**: 241–251, https://doi.org/10.1680/jgeen.19.00082.

Zhuang Y, Cui X, Dai G, Geng X and Li S (2021) An analytical method for a pile-stabilised slope considering soil anisotropy. *Proceedings of the Institution of Civil Engineers – Geotechnical Engineering* **174(3)**: 252–262, https://doi.org/10.1680/jgeen.19.00108.