Interaction between tunnel excavation and historical structures in urban areas: a fully coupled structural and geotechnical approach.

A. Amorosi[†], M. Sangirardi[*], G. de Felice[*] and S. Rampello[†]

[†] Department of Structural and Geotechnical Engineering, Sapienza University of Rome
Via Eudossiana 18, 00184, Rome, Italy.
e-mail: angelo.amorosi@uniroma1.it, sebastiano.rampello@uniroma1.it - Web page: https://web.uniroma1.it/disg/

[*] Department of Engineering, Roma Tre University
Via Vito Volterra 62, 00146, Rome, Italy.
e-mail: marialuigia.sangirardi@uniroma3.it, marialaura.malena@uniroma3.it, gianmarco.defelice@uniroma3.it – web page: https://www.romatrestrutture.eu/

ABSTRACT

The development of urban mobility implies the construction of tunnels, often interacting with valuable historical structures. It is thus necessary to develop rational and reliable procedures to estimate the potential excavation-induced damage. In essence, this objective corresponds to solve the related soil-structure interaction problem. Classical approaches to soil-structure interaction are often characterised by relatively simple schematisations for either one or both components of the problem, as, for example, springs for the soil or equivalent plates for the structure. Such simplified assumptions prove to be appropriate for simple soil-foundation cases, while show all their limits when tackling more complex problems, as those involving the excavation in the vicinity or beneath historical masonry structures. In such cases, the need for reliable prediction of the potential damage induced by construction activities on surface structures justifies the adoption of more advanced numerical approaches, based on realistic constitutive assumptions for both soils and masonries, together with an accurate modelling schematisation of the excavation process.

This is what proposed in this paper, where a 3D Finite Element approach is adopted to realistically model the excavation process, the strongly non-linear soil behaviour and the non-linear anisotropic response that characterise masonry structures, those latter here included accounting for their 3D geometrical characteristics. This contribution takes advantage of the well documented previous research activities of the Authors in this field (e.g. [1]- [3]), while focusing on some specific case studies related to the ongoing construction of the Metro C line in Rome.

REFERENCES

[1] S. Rampello, L. Callisto, G. Viggiani, and F.M. Soccodato, “Evaluating the effects of tunnelling on historical buildings: the example of a new subway in Rome”, *Geomechanics and tunnelling*, Vol. **5**(3), pp. 275-299, (2012).

[2] A. Amorosi, D. Boldini, G. de Felice, M. Malena and M. Sebastianelli, “Tunnelling-induced deformation and damage on historical masonry structures” *Géotechnique*, Vol. **64**(2), pp. 118-130, (2014).

[3] W. G. Lasciarrea, A. Amorosi, D. Boldini, G. de Felice and M. Malena, “Jointed Masonry Model: a constitutive law for 3D soil-structure interaction analysis”, *Engineering Structures - Under Review*, (2019).