The preservation of monuments and Historic Sites has gained interest and has seen an increasing involvement by geotechnical engineers since late Seventies. This theme is one of the most challenging problems of our age. It involves a number of factors belonging to different fields: cultural, humanistic, social, technical, economical and administrative. From an engineering point of view an, the peculiarity of these type of interventions consists of the requirement of preserving the entire integrity, besides guaranteeing the safe use of the structures. Geotechnical engineering, by analyzing the foundation behavior and the soil structure interaction, can play a key role for the development of successful conservation designs. In such a framework, the research activities of this group focus on the understanding and prediction of historic structure behavior. This is achieved starting from the analysis of historical documents and collection of information related to the case studied. Then, on the base of such information in-situ investigations and monitoring on the foundation structure and on the subsoil must be carried out. Once all data have been collected, advanced analysis methodologies (Fig. 1) can be applied to the detailed geotechnical model of the foundation, usually shallow in historical structures. The response of shallow foundations subjected to general loading conditions has been studied by the research group for the last two decades, through the macro-element approach, which enables to consider the external resultant forces applied to the foundation (V, M/B, H) and the corresponding displacements (w, θB, u) as generalised stress and strain variables (Fig. 1 and Fig. 2).

The research group has moved from extensive experimental campaigns involving several 1g and centrifuge tests carried out on shallow foundation models. Within such context, the effects of footing embedment and cyclic loading conditions are currently under investigation, in order to extend the approach to buried foundations of slender structures such as historic towers (Fig. 3).

These models have been also modified to accommodate other important phenomena such as the soil creep, in order to explore the time dependent stability of historic towers. The research is carried out in collaboration with the University of Southampton and the Centre for Offshore Foundation Systems of Perth (Western Australia).

Fig. 1. Various ways of modelling the soil foundation system: springs, finite elements and strain hardening plasticity models (macro-element approach) (modified from Marchi et al., 2013).
Fig. 3. The ‘Two Towers’ in Bologna (Italy): an example of historical structures with shallow foundations subjected to combined loading (Picture by Marchi M.).

MAIN PUBLICATIONS


Govoni, L., Gourvenec, S., Gottardi, G. and Cassidy, M.J., Drum centrifuge tests of surface and embedded footings on sand, Proceeding of the International Conference on Physical Modelling in Geotechnics, Hong Kong, China, 4-6 August 2006, pp. 651-657.


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