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High-Frequency Monitoring Results of a Piled Raft Foundation under Wind Loading

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Abstract : Piled raft foundations represent an efficient and reliable technique for transferring high vertical and horizontal loads to the subsoil. Piled raft foundations were successfully implemented for several high-rise buildings worldwide over the last decades. For the structural design of this foundation type the stiffnesses of both the piles and the raft have to be determined for the static (e.g. dead load, live load) and the dynamic load cases (e.g. earthquake). In this context the question often arises, to which proportion wind loads are to be considered as dynamic loads. Usually a piled raft foundation has to be monitored in order to verify the design hypotheses. As an additional benefit, the analysis of this monitoring data may lead to a better understanding of the behaviour of this foundation type for future projects in similar subsoil conditions. In case the measurement frequency is high enough, one may also draw conclusions on the effect of wind loading on the piled raft foundation. For a 41-storey office building in Basel, Switzerland, the preliminary design showed that a piled raft foundation was the best solution to satisfy both design requirements, as well as economic aspects. A high-frequency monitoring of the foundation including pile loads, vertical stresses under the raft, as well as pore water pressures was performed over 5 years. In windy situations the analysis of the measurements shows that the pile load increment due to wind consists of a static and a cyclic load term. As piles and raft react with different stiffnesses under static and dynamic loading, these measurements are useful for the correct definition of stiffnesses of future piled raft foundations. This paper outlines the design strategy and the numerical modelling of the aforementioned piled raft foundation. The measurement results are presented and analysed. Based on the findings, comments and conclusions on the definition of pile and raft stiffnesses for vertical and wind loading are proposed.

Keywords : design, dynamic, foundation, monitoring, pile, raft, wind load
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