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G. Viggiani, D. Salciarini, F. Silvestri, C. Tamagnini, G.M.B. Viggiani (Eds)
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IMPORTANCE OF DYNAMIC SOIL STRUCTURE INTERACTION IN THE SEISMIC PERFORMANCE ANALYSIS OF BUILDINGS FOUNDED ON PILES

L. de Sanctis[1]

[1]Department of Engineering
University of Napoli Parthenope, Italy
e-mail: luca.desanctis@uniparthenope.it

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Summary. The dynamic response analysis of a building founded on pile is often carried out according to the conventional approach, in which the change of free-field motion generated by piles is disregarded and the structure is considered as fixed-base. In addition, site effects are usually evaluated according to code-defined subsoil classifications. On the other hand, piles have the potential to filter out the free-field input motion (Fig. 1), while pile foundation compliance can lead to an increase of both the fundamental oscillation period and the damping of the fixed-base structure.

In order to highlights the importance of the above aspects, the case study of a tall public building is presented and discussed. The building, about 100 m high, is supported by a piled-box foundation floating in a thick layer of soft pyroclastic and alluvial soils (Fig. 2). Following the conventional approach, the inertial seismic actions on the building would lead to expensive measures for seismic retrofitting. Nevertheless, if site effects and soil-structure interaction are adequately address the picture is completely different. First, due to a soft peat layer, the 1-D wave propagation analyses produced reduced spectral accelerations at ground surface. FE analyses of pile-soil kinematic interaction were then carried out to evaluate the horizontal and rotational base motions; the change of the free-field motion generated by piles was found not to affect significantly the seismic actions on the building. The effects of inertial interaction were evaluated accounting for pile foundation compliance; they resulted into an increase of the fundamental structural periods of vibration and, thus, to a further reduction of the spectral accelerations. Finally, a novel exact solution was applied to evaluate the contribution of the foundation to the overall damping, which was found to be very close to that of the fixed-base structure. These results may have a significant impact on the employment of seismic risk mitigation strategies for piles-supported buildings.

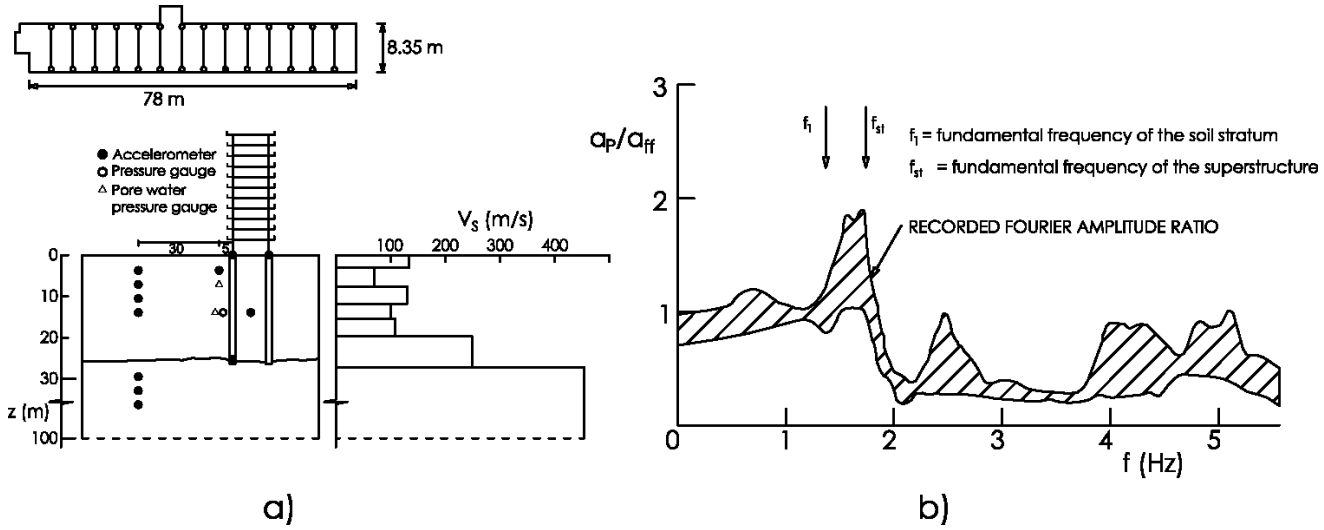

Figure 1. Case history on the filtering action exerted by piles: (a) plan and section of the building; (b) recorded ratio of Fourier amplitude spectra atop the pile and at the free-field ground motion (modified from Gazetas [1984]).

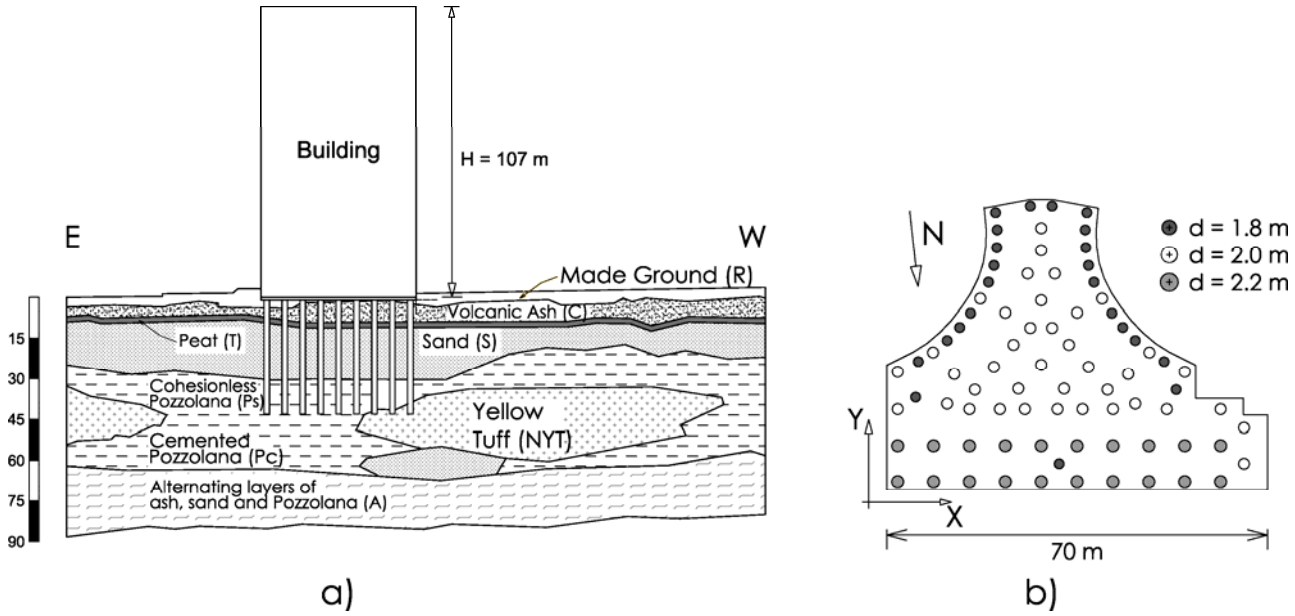

Figure 2. Cross section (a) and plan view (b) of the New Law Court Building in Napoli

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