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IGT-Kolloquium

Friday, 7 December 2018

Dynamic wave-soil-structure interaction of offshore structures. Experiments, numerical simulation and analysis methodologies

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14:30 pm, ETH Zurich, Hönggerberg, HIL E7

The ongoing research activities at the Dept. of Civil Engineering of the University of Thessaly, concerning the dynamic wave-soil-structure interaction of offshore structures (jackets, compliant towers, wind towers, etc.) will be presented. It has been recognized even from the ‘80s that when the fundamental period of these structures is significantly lower than the dominant period of the wave, a static analysis taking into account the wave loading only, is sufficient. However, slender structures, that have a fundamental period close to the wave period, might respond dynamically and resonance phenomena might occur. To investigate the above phenomena, a series of experiments were designed and executed at the INSEAN research center facilities in Rome, within the framework of a MARINET2 EU action. The experiments concerned a 5m high steel platform with elastic horizontal and vertical supports, that model the participation of the foundation soil and the overall flexibility of the structural system. The structure was attached at the bottom of the towing tank and was excited by means of waves having various different characteristics (wave heights, periods, etc.), in order to study the structural response in terms of forces and displacements. In the sequel, a numerical model was developed in order to simulate the experiments, using time-history nonlinear dynamic analysis.

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In general, this type of analysis, is the most appropriate one to be applied to capture the exact response of structures under wave loading, however, it is complex and time consuming. For this reason, a simplified methodology was developed, employing static analysis only, that can adequately approximate the maximum response yielded by the dynamic analysis. To this end, various types of time-history dynamic analyses were first applied on a detailed structural model of an actual compliant tower in deep water, ranging from linear to fully nonlinear, that were used as reference solutions. In the sequel, a simplified analysis model was formulated, capable of reproducing the response of the entire structure with significantly reduced computational cost. In the next stage, this model was used to obtain the linear and nonlinear response spectra of the structure. Finally, these spectra were used for the development of a static analysis methodology, that produces good results in cases that the response is mainly governed by the first eigenmode, which is the case when compliant towers (and other types of rather flexible offshore structures) are considered.

Prof. Euripidis Mistakidis

Prof. Mistakidis received his Diploma in Civil Engineering from the Aristotle University of Thessaloniki, in October 1987 and his Doctoral degree from the same University in June 1992. Currently he is Professor of Structural analysis and Head of the Department of Civil Engineering of the University of Thessaly (UTH), Greece. His main research interests include analysis and design of steel and composite structures, buckling and stability of structures, behaviour of steel and composite structures at elevated temperatures, dynamics of offshore structures (wave-soil-structure interaction), analysis and design of cementitious shells and improvement of the seismic behavior of existing structures through innovative technologies. Apart from his academic career, Prof. Mistakidis has worked for more than 25 years as consultant for the structural design of special projects in Greece and abroad. Among the projects with which he has been involved, are the large steel roof of the Olympic stadium of Azerbaijan at Baku, the 100m diameter steel dome of the multipurpose Al-Sadd sports hall in Doha, Qatar and the seismic strengthening of large multistory buildings in Athens and other Greek cities.