Form 2

Dissertation Abstract

Report no.	(Course-based) No.1145	Name	Md. Shajib Ullah
Dissertation title	Dynamic behavior of steel pipe sheet pile foundations （銅管矢板井筒基礎の動的挙動に関する研究）		

Steel pipe sheet pile (SPSP) foundation, a different kind of underground supporting structure in terms of structural configuration compared to other popular types of foundation (e.g. ordinary pile or caisson) is selected as the subject of this research work. Application of SPSP foundation has earned widespread popularity in various parts of the world due to its large bearing capacity and high bending rigidity which can provide an efficient geotechnical solution in certain demanding conditions, for example, to support large scale bridge structures where the ground is soft. The dynamic response behavior of SPSP foundation and structures supported on it considering the soil-SPSP foundation-superstructure (S-SPSP-S) interaction effect has been investigated in this current study since such behavior is largely unknown and unavailable in the literature.

Physical model testing approach to understand the behavior of real field prototype system has been adopted considering appropriate scaling technique. Firstly, to realize the real SPSP joint behavior through equivalent scaled model joint, the vertical shear resistance behavior of such model joint is evaluated experimentally, and an analogous trend has been seen with the available filed test result and the provision laid in the design code for SPSP joint.

The components of well-known sub-structuring technique for dynamic response analysis of S-SPSP-S system namely- the kinematic interaction effects and the inertial interaction effects are evaluated through shake table experiment and SPSP foundation head loading test, respectively under 1-g condition. A scaled model of soil-SPSP foundation system has been utilized for the experiments. Low-to-high amplitude of input excitation for a wide range of frequency has been employed in these experiments to induce low-to-high level of strain in soil and to encompass typical structural and soil natural periods.

Frequency and intensity dependent effective foundation input (EFIM) have been estimated for the kinematic interaction part through vibrating the soil-SPSP foundation system under controlled conditions on a shaking table. The effect of kinematic interaction between soil and foundation structure has been captured in terms of kinematic interaction factor (KIF). Frequency and intensity dependent SPSP foundation head impedance function (IFs) has been estimated for the inertial interaction part by vibrating the head of the foundation system. The stiffness and damping characteristics of the soil-SPSP foundation system are captured through this experimental investigation.

Frequency and intensity dependent total dynamic response of superstructure and footing of a S-SPSP-S system have been evaluated through model testing by exiting such S-SPSP-S system model on a shaking table. The dynamic responses encompassing the resonance behavior of the superstructure and the foundation of the S-SPSP-S system is evaluated and the results are further employed to verify the performance of the sub-structuring technique in estimating dynamic response of superstructure supported on SPSP foundation.

Simple analytical formulas have been derived considering a single-sway model of S-SPSP-S system following the solution steps of sub-structuring technique to estimate the total dynamic response of superstructure and footing of the S-SPSP-S system. Independently estimated experimental EFIM and IFs of SPSP foundation are superimposed to obtain such responses. Finally, the superimposed results are compared with experimentally estimated responses. The comparison shows certain discrepancies and reveals the possible influence of the joint stiffness variation resulting from the profound influence mass of superstructure and footing on the dynamic behavior of S-SPSP-S system.

As a whole, the results and discussions presented in this dissertation will provide the reader a detailed insight on the fundamental dynamic response behavior of the soil-SPSP foundation system and superstructure supported on it.