Geotechnical Investigation for Housing Construction by Swedish Ram Sounding in Japan

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ABSTRACT
This report explains the applicability of Swedish Ram Sounding (SRS) as a soil investigation method in the design of housing foundations. In this report, we confirmed the relationship between $N_d$-values obtained from SRS and $N$-values obtained from SPT. We calculated $N_d$ and $N$ values by practical tests using the friction resistance of surrounding surface of the rod in SRS. As a result of calculating bearing capacity factor of steel pipe pile, we found that SRS is very practical as a soil investigation method to design pile foundations for housing. Furthermore, we also found that the sampling device for SRS, which was developed to directly determine the soil property, can be utilized for soil property determination.

KEY WORDS: Swedish Ram Sounding; $N_d$-value; steel pipe pile; sampling; foundations; houses.

NOMENCLATURE

- $A_p$: Effective cross-section area of the foundation pile tip
- $M_v$: Rotary torque of the rod in SRS
- $L_{cu}$: Total length of soil surrounding the foundation pile which has contact with sand ground
- $L_{ck}$: Total length of soil surrounding the foundation pile which has contact with clay ground
- $\overline{N}$: Average $N$-value of soil near the foundation pile tip
- $\overline{C}$: Average $N$-value of clay ground in the soil surrounding the foundation pile
- $N_{dm}$: Blow count in SRS
- $\overline{N}_c$: Average $N$-value of sand ground in the soil surrounding the foundation pile
- $\overline{N}_c$: Average value of unconfined compression strength of clay ground in the soil surrounding the foundation pile
- $R_{ax}$: Allowable bearing capacity of the foundation pile
- $R_{at}$: Ultimate vertical bearing capacity of the foundation pile
- $\alpha$, $\beta$, $\gamma$: Factor obtained from the load test result
- $\kappa$: Factor to calculate $N_d$-values
- $\psi$: Girth of the foundation pile

INTRODUCTION
The Swedish Weight Sounding Test (SWS) is widely used for the soil investigation in detached house constructions in Japan. However there are cases where SWS alone is not sufficient. Most urban areas in Japan are covered with soft alluvial formation; therefore, the small size steel pipe pile is becoming important for designing housing foundations as a countermeasure against house settlement and leaning houses. To design the pile for housing, the most important thing is to determine the ground conditions such as bearing ground. From this point of view, there are some problems, such as the penetration ability of SWS not being sufficient, and the measurement distance in SPT being too long for designing the small size pipe pile with a diameter of approx. 20cm. SRS, which is recently beginning to be used in a part of Japan, has a relatively easy investigation method with penetration ability of $N$-value of approx. 50, and provides continuous data for every 20cm penetration. SRS is the Dynamic Probing Test, one of the in-situ soil investigation methods, which is standardized by ISO-22476-2.

Table 1 shows four types of Dynamic Probing, in which SRS falls into DPSH-A type. Recently, test devices with improved working efficiency have been developed by adding machine control functions and data record functions. However, at this time in Japan, SRS is not yet standardized or substantially established as an investigation method. We presume that there are some issues to establish SRS as one of the soil investigation methods in Japan.

In this report, we discuss the correlation between SRS and SPT focusing on rod frictions, explain the calculation result of bearing capacity factor of the pile in SRS, and the trial result for the sampling device used together with SRS.