WATER SEEPING THROUGH BORED PILES IN DEEP EXCAVATION PROJECT IN BANGKOK

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1. INTRODUCTION

At present, demand for deep excavation construction has been increased in Bangkok city because of optimum land usage. The high-rise hotel project is located at Asoke intersection on Sukhumvit road which is the main central business district in the city. The basement consists of three basement at the level of -3.80 m., -7.80 m. and -12.00 m. with the maximum depth of excavation of -14.80 m. using 0.80 m. thick diaphragm wall as a soil protection system. There are three layers of steel bracing at – 2.00 m., -6.00 m. and -10.50 m. as presented in Fig 1. The building is supported by bored pile foundation with tip penetrated in the second very dense sand layer. At -59.00 m., during excavation to pile cut off level, water seepage through the pile was observed at the pile cut off. Pile condition was checked for every pile by seismic integrity test. This paper presents case report of water seepage in bored pile foundation.

2. BANGKOK SOIL CONDITIONS

Five boreholes of approximately 65-70 m. were conducted to investigate soil condition. It consisted of a 13.5 m. thick of soft to medium stiff clay layer followed by stiff to very stiff clay from -13.50 to -22.00 m. Hard silty clay and dense silty sand layer were encountered below the soft to medium clay layer. At -52.00 m, 5 m. thick hard clay layer was detected followed by the second very dense sand layer. Fig 2 illustrates soil profile together with soil properties such as unit weight and shear strength as well as SPT N-Value.

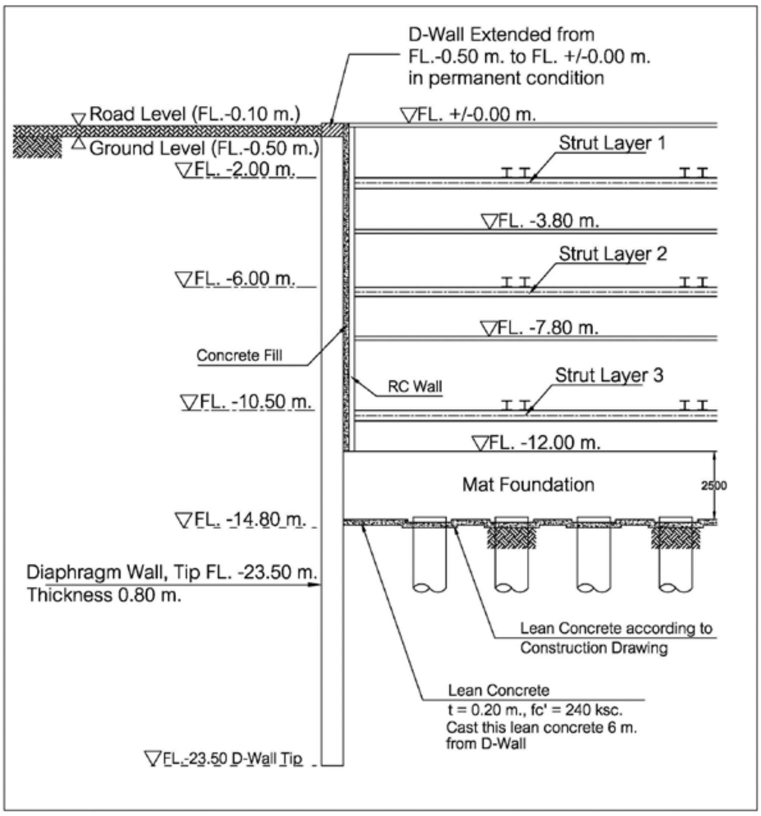

Fig. 1 Typical cross section of the high-rise Hotel basement construction project.

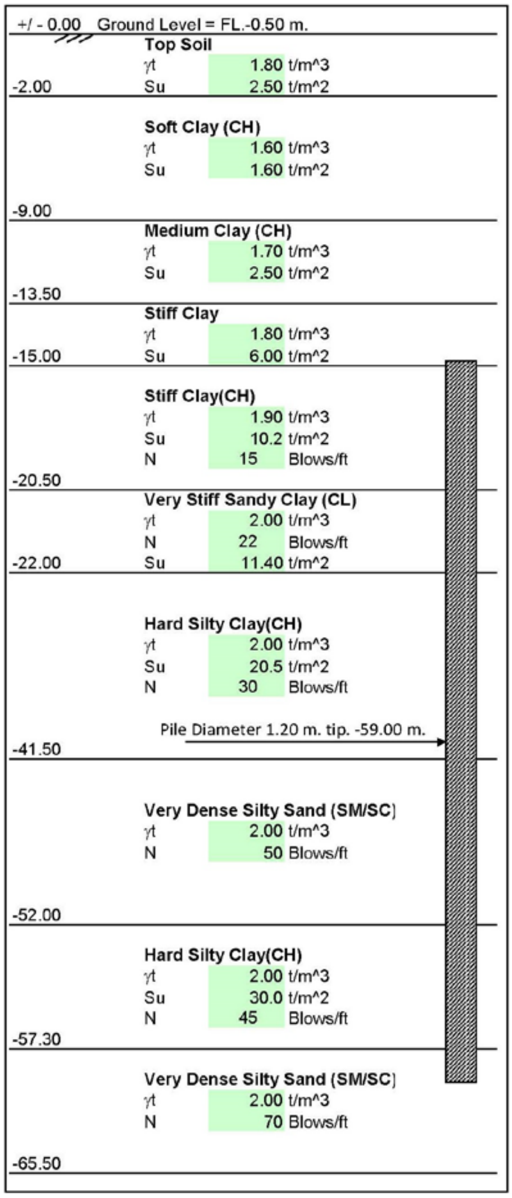

Fig. 2 Soil Profile

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Groundwater condition of Bangkok is hydrostatic starting from 1.0 m. The piezometric level of Bangkok aquifer was lowered to -23.00 m. due to deep well pumping in the past. Since the Thailand government prohibited deep well pumping to protect ground subsidence, recent piezometer data record showed that the piezometric level has increased up to -13.00 m. below ground surface.

3. PILE DESCRIPTION

Foundation of this project was designed as pile foundation with 1.20 m. diameter wet process bored pile and pile tip penetrated in the second dense sand layer at -59.0 m. as also illustrated in Fig 2. The wet process bored pile is constructed by using polymer based slurry with a ratio of 1.00% slurry volume bentonite and 0.08% volume polymer as a stabilizing agent (Teparaksa and Boonyarak, 2002). Cylindrical concrete strength of 300 ksc was used for casting piles. Ultimate pile capacity was calculated to be 1980 tons/pile or allowable pile capacity of 850 tons/pile providing safety factor of about 2.3. Static pile load test was carried out on a pilot pile to confirm pile capacity. By employing Mazerkiewicz's method, the ultimate failure load was confirmed to be 2190 tons. There were in total 55 piles. At present, soil was excavated to the final depth and 46 piles were already trimmed at cut-off level

4. WATER SEEPAGE THROUGH PILES

Diaphragm wall with 0.80 m. thick, 23.50 m. long was used as a soil protection system. Bottom up method of construction was employed for deep basement construction started by excavating to the final level with 3 layers of steel strut bracing. Then mat foundation and base slab are casted from bottom to the top respectively. It is noted that piles were casted before starting soil excavation. During excavating to the final level, the pile head was trimmed to prepare for reinforce with the mat foundation.

However, in this project, after trimming the pile head, there was water seeping out from the pile at pile cut-off level which promotes concern for long-term behavior (see Fig. 3). This phenomenon is very rare to be seen as far as the authors experienced. First suspect was that the pile might be defected or there is a crack at some depth. Therefore, pile seismic integrity test was carried out. However, the results showed that all the piles were in perfect condition. Pile capacity was already proved. Up to date, 46 piles was trimmed. Water seepage was observed in 40 piles out of those given percentage of water seepage of 86.95%. There are several possible causes. Permeability of concrete might be high due to concrete mixture. In this project, fly ash was mixed in the ratio of 40% which was much different from usual practice in Thailand of about 15%.

Moreover, pore water pressure was high. The water seepage can start from the very dense sand layer at -41.50 m. (see Fig. 2) and seep upward to the pile cut off level at -14.80 m. The head of ground water table is 41.50-13.00 = 28.50 m. The water can seep through the capillary inside of the bored pile. Remedial work is planned by grouting PU foam.

5. CONCLUSIONS

This paper presents a case report of water seepage through deep bored piles during construction of deep basement of the high-rise hotel project in Bangkok. Bottom-up method of construction was used with diaphragm wall as a temporary wall during excavation and as a permanent wall after completion. There were three steel bracing layers. The maximum depth of excavation of -14.80 m. from ground surface. After excavating to the final depth, there was water seepage observed at pile head during pile head trimming at cut-off level of more than 85%. This phenomenon is rarely seen as for as the authors concern. There are several possible causes; for example, percentage of fly ash mixture together with high water head. To minimize the possible long-term durability, PU form grouting shall be conducted to stop the water seepage before casting mat foundation.

Fig. 3 Photo of water seepage at pile head

6. REFERENCES

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