SHALLOW EXCAVATION WITH DIAPHRAM WALL TO MINIMIZE SURROUNDING SOIL DISPLACEMENT IN BANGKOK SUBSOILS

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1. INTRODUCTION

Bangkok subsoils consists of a thick soft clay layer of about 13 m. from ground surface which promotes difficulty in soil excavation works. In general, for shallow excavation (less than 9 m.) sheet pile is used as a temporary soil retaining structure to save construction cost. For the deeper excavation, either pile wall or diaphragm wall is employed [1]).

Recently, surrounding impact to neighbor due to soil excavation in terms of soil displacement and settlement is concerned. There was a 7.5 m. excavation project located in Sukhumvit 29, Bangkok where sheet pile is capable of soil retaining structure. However, because of surround settlement awareness, diaphragm wall of 0.80 m. thick is employed. This paper reports performance of diaphragm wall in shallow excavation in Bangkok subsoil.

2. SOIL CONDITION

The soil condition is typical Bangkok subsoil with relatively thicker soft clay and medium stiff layer. The stiff clay layer was encountered at -17.00 m from ground surface. Comparing to the nearby project (200m away), the stiff clay layer was found at about just -14.00 m. Two meters of the first sand layer was found at -20.00 m. to -22.00 m. Below the sand layer, it was a very stiff to hard clay layer up to -30 m. The ground water of Bangkok during design and construction was about -13.00 m. As the level of groundwater is far below the excavation depth, this project is very safe against uplift pressure.

2. PROJECT DESCRIPTION

The underground excavation project is located in the city center of Bangkok. It consisted of basement floor and water tank with maximum excavation depth of 7.85 m. The top of water tank and basement level B2 are EL.-5.75 m. and 3.85 m. respectively. Th basement level B1 is at EL.-1.85 m. as shown in figure. The construction method was bottom-up with two layers of temporary bracing at EL.-1.30 m. and -3.25 m. Diaphragm wall of 0.80 m. thick with 20.00 m. length was used as a soil retaining structure. With the excavation depth of only 7.85 m., diaphragm wall is conservative for minimization of horizontal displacement and surrounding settlement. During construction there were five inclinometers located on each side of the construction area to monitor performance of the D-wall.

3. DIAPHRAGM WALL ANALYSIS AND MONITORING RESULTS

Behavior of diaphragm wall was analysis using Finite Element Method (FEM) for bending moment, shear force and displacement with all construction sequences starting with the first excavation to casting ground floor. The results of bending moment and shear force were used to design main and stirrup reinforcement and the displacement was used for safety monitoring. The maximum horizontal displacement was used to set trigger level denoted as Alarm, Alert and Action with 70%, 80% and 90% of the FEM computed maximum displacement as shown in Table 1.

During construction, the horizontal movement of the D-wall was monitored with five inclinometers on each side of the construction area. At the end of construction (After casting ground floor), the maximum reading ranges from 7.20 to 23.43 mm. as demonstrated in Table 1. It can be seen that performance of diaphragm wall for shallow excavation in terms of retaining wall displacement was exceptional.

Table 1. Trigger level of diaphragm wall horizontal displacement

Inclinometer Number	Reading at Final Stage (mm)	Trigger Level		
		Alarm (mm)	Alert (mm)	Action (mm)
IW1	23.43	38.34	43.82	49.03
IW2	13.94	34.06	38.92	43.79
IW3	7.20	33.69	38.51	43.32
IW4	17.82	33.69	38.51	43.32
IW5	10.12	38.34	43.82	49.03

4. CONCLUSIONS

This paper reports performance of diaphragm wall for shallow excavation in terms of wall horizontal displacement after ground floor completion. It was observed that wall displacement was exceptionally low comparing to FEM predicted value. Thus, for the underground construction surrounded by sensitive structure, diaphragm wall is recommended.

REFERENCES

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