Effects of heave on the construction of a tension wall foundation in Rotterdam

O. Oung, R. Elprama & G. Hannink, Rotterdam Public Works, Rotterdam, The Netherlands

Discussion theme: session 2

Nowadays, it is a common practice in most civil engineering projects to compensate the lack of space in urban areas by building in the underground as deep as it is needed. Underground constructions combined with deep excavations are complex to realise. In the Netherlands, the relatively high groundwater level is an important issue to be considered when carrying out deep and dry excavations. Water conditions have to be carefully defined and controlled for the sake of the stability and the dewatering of the excavation pit.

In Rotterdam, the underground is made of Holocene layers (clay, peat) starting at ~NAP –4 m (NAP = Normal Amsterdam Peil = Dutch metering system), Pleistocene sand at ~NAP –17 m and the Kedichem formation (clay, sand, peat, loam) from ~NAP –34 m. The soft cohesive soils make ground deformations also an important issue to deal with when designing the constructive elements.

In Rotterdam, along the light-rail line of RandstadRail, a number of deep excavations are realised. In the same period of time, the underground station Rotterdam CS will be renewed and extended. In the city centre, several deep underground parking facilities are to be constructed. These projects provide quantitative monitoring data including in-situ measurements on soil parameters and soil behaviour. These data give a better insight in the deformation behaviour of the various soil layers, especially that of the deep layers which are important for designing deep excavation pits.

In case of the parking facility at Kruisplein in Rotterdam, the permanent basement floor lies at NAP –20 m. In the final situation, the basement floor has to resist the uplift caused by a water pressure with a value of 180 kPa. In stead of tension piles, diaphragm walls as tension ‘walls’ turned out to be the optimal solution to hold the basement floor in place.
The assumption that friction generated by the sand layer along the diaphragm walls is sufficient to retain the floor when uplift takes place has to be checked.

The paper analyses the mechanism leading to swell and settlement per construction stage. Because the relative vertical deformations between soils and foundation elements affect directly the hold capacity of the tension elements. Both Finite-Element and analytical calculations and in-situ measurements were used to support this study. Special attention will be given to the boundary conditions of the water pressures.

Author’s address for correspondence:
Dr. O. Oung
Rotterdam Public Works
P.O. Box 6633
3002 AP Rotterdam
The Netherlands
Tel: +31 (0)10 489 7078
Fax: +31 (0)10 478 0595
O.Oung@gw.rotterdam.nl