Pumping Plant IJmuiden (the Netherlands)

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Because large areas in the Netherlands are below sea level the water discharge is very important. The largest pumping station of Europe is situated at the outlet of the North Sea-canal. This canal connects the city of Amsterdam with the North Sea. The 25-year old complex needed renovation and an increase of its capacity. In a Design & Build contract by contractors VBK-Van Laere, Grontmij Consulting Engineers took care of the complete engineering of the extension. The pumping plant IJmuiden, built in 1975, is situated at the site of sluice complex IJmuiden. The plant is an important link in the watermanagement of the West and Central part of the Netherlands. The plant had a capacity of up to 8 billion m³ per 24 hours, which equals a capacity of 150 m³ per second. Even now rainfall increases, sea level is rising and the land is declining. Due to these factors the capacity of the pumping station needed to be increased to 250 m³ per second. The principal of the work was the Civil Engineering division of the Department of Public Works and Watermanagement.

The expansion of the pumping plant will be realized by a building-pit between the present pumping plant and the harbour of Corus. During the work the present pumping plant should stay in function and in case of emergency be able to protect the land against the sea. Because of these requirements extensive soil survey have been taken place.

The main result of the soil survey was the existence of a soil improvement of sand under the present pumping station. Granular distribution tests on this sand showed a fine gradation and therefore a risk of liquefaction during the work. While installing the sheet piles and foundation elements in the sand layer, the water pressure has been monitored accurately. Another result of the soil survey was the presence of a slightly sandy clay layer some meters below the bottom of the excavation. Because this layer was slightly permeable the excavation had to be realized by a concrete floor with tension elements (vertical anchors).

To control deformations of the soil below the present pumping station, the excavation has been modelled with the finite element computer programme PLAXIS. The main purpose of this model was to investigate the influence of the excavation and dewatering on the horizontal and vertical deformations of the soil. Special care has been given to the vertical anchors and the relaxation of the soil. The rincipal demanded a maximum deformation, vertical and horizontal, of 5 mm, however more deformation was allowed if could be proved that larger deformation wouldn't have a negative effect on the functionality of the present pumping station. With the help of the finite element model the design and phasing have been defined in a way that the present pumping station doesn't experience too much deformation.

The calculations shows that first, during excavating and dewatering the building-pit, the vertical transformation is upwards. After which, during the expansion of the pumping plant, a settlement has been calculated. The calculated settlement of the expansion is 14 mm (in a drained situation). During the realisation of the building-pit and the expansion, the deformation of the present pumping station have been accurately monitored. The monitoring results show that the measured deformations are similar to the calculated deformations and meet the demands of the principal.

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