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VolkerWessels: we present solutions for every geotechnical challenge

Summary

VolkerWessels is a close-knit group of companies, working in construction and related fields. Its 100 operating companies trade as independent entities with their own profit and market responsibility. VolkerWessels has a turnover in excess of € 4.4 billion (2009). The operating companies form part of a strong internal network, within which they cooperate in the areas of business development, staff development and communications.

Both in the UK and the Netherlands VolkerWessels has operating companies in the field of foundation construction and engineering. These companies operate worldwide and are capable of fulfilling all your construction requirements when dealing with challenging ground conditions. This paper will present both general information of our companies and some of the special techniques that are available from VolkerSteel Foundations Ltd., Volker Staal en Funderingen B.V. and VolkerWessels Stevin Geotechniek B.V., all part of the VolkerWessels group.

At the 11th DFI conference VolkerWessels will present two papers about the foundation techniques that the companies have developed, executed and tested in recent years. The introduction of large diameter cased piles and vibrated VM piles has been a success in the Netherlands and we consider these techniques to be interesting for the UK market as well.

Figure 1 *Floating barge with piling equipment.*

Large diameter bored casing piles

The railway extension project between three major Dutch cities, The Hague, Rotterdam and Utrecht, was commissioned by the Dutch railway authority, Prorail, in 2005. Near the city of Utrecht the extension includes the construction of a new embankment for four railroad tracks and a total of 20 new railway viaducts. These viaducts will provide a safe passage for the people living in the new residential area of Leidsche Rijn.

In the original client design all bridges had piled foundations. The foundations of abutments and footings consisted of thick concrete slabs with a large number of driven prefabricated concrete piles, which are commonly used in the Netherlands. Since the bridges themselves were supported by columns of 1.2m in diameter an alternative design was made to use bored casing piles with a diameter of 1.65m, one pile below each column. Instead of using 80 prefabricated concrete piles, columns could be constructed on six of these casing piles. Also the heavy concrete slab (for which dewatering and additional temporary facilities were necessary) could be omitted. The alternative foundation had to meet strict client requirements. The piles have a design pile load of 12.000kN, but should also have a vertical deformation less than 10mm during train passage. Since bored piles normally have a flexible load-displacement behaviour, it was deemed necessary to equip the piles with a grouting device at the pile tip.

The casing piles were bored without a stabilising fluid such as bentonite. During drilling and removing the ground inside the casing, it was therefore essential that a higher water level was maintained in the casing than the actual groundwater head at the pile tip. To minimise the risk of disruption of the ground at the pile tip the piles were equipped with a grouting device that was injected after hardening of the concrete of the piles. By filling the grouting device under high pressure it was possible to pre-stress the pile tip (and hence the entire pile) to guarantee a stiffer load-settlement behaviour.

The execution method of the bored casing piles is presented in *figure 2*.

The use of bored, large diameter casing piles with base grouting, was a first time application in the Netherlands. Therefore it was decided to use Cone Penetration Tests (CPT's) as a way of checking the influence of the installation of the pile on the surrounding soil. A total of three piles were instrumented and tested on site by means of a static load suitability test and the deformations of all piles were monitored during construction up to the actual completion of the works. In order to get information on the pile behaviour under even larger loads two extra piles were tested by means of a statnamic load test with a 16MN device. The statnamic load test results were interpreted according to international standards and have been analysed using numerical modelling with the finite element program Plaxis.
Based on the CPT results, pile load tests (both static and statnamic) and the monitoring results of the deformations of all piles during construction, a very good understanding was reached regarding the ultimate bearing capacity and the load-settlement characteristics of these piles.

Vibrated VM piles

Part of the North/South line metro extension in Amsterdam, the Netherlands, is the construction of the RAI - Europaplein station. This station is situated in front of the RAI complex, the most important exhibition and congress centre of the Netherlands. The metro tunnel and station were constructed in a building pit with sheet piling, underwater excavation and underwater concrete. Due to the high groundwater levels tension piles are necessary during construction. Once the station is completed a number of piles will remain in tension, while others become compression piles.

The station floor is situated at 11m below ground level. The design pile loads vary from 1.100 kN compression load to 700 kN tension load. As a result pile tip levels varied from 28 to 31m below ground level, approximately 20 m below the bottom of the excavation.

Since a stiff load-settlement behaviour of the piles was required by the design, both in tension and compression, and the impact on the RAI congress centre should be as minimal as possible, the client decided to use Rüttel-Injectionspfahle which are commonly used in parts of Germany. These piles, that can be described as vibrated H-beams with grout injection along the shaft, were new to Dutch foundation practise and had to be tested both prior to the installation (design investigation tests) and after installation (acceptance tests) in order to meet the demands of the building authority.

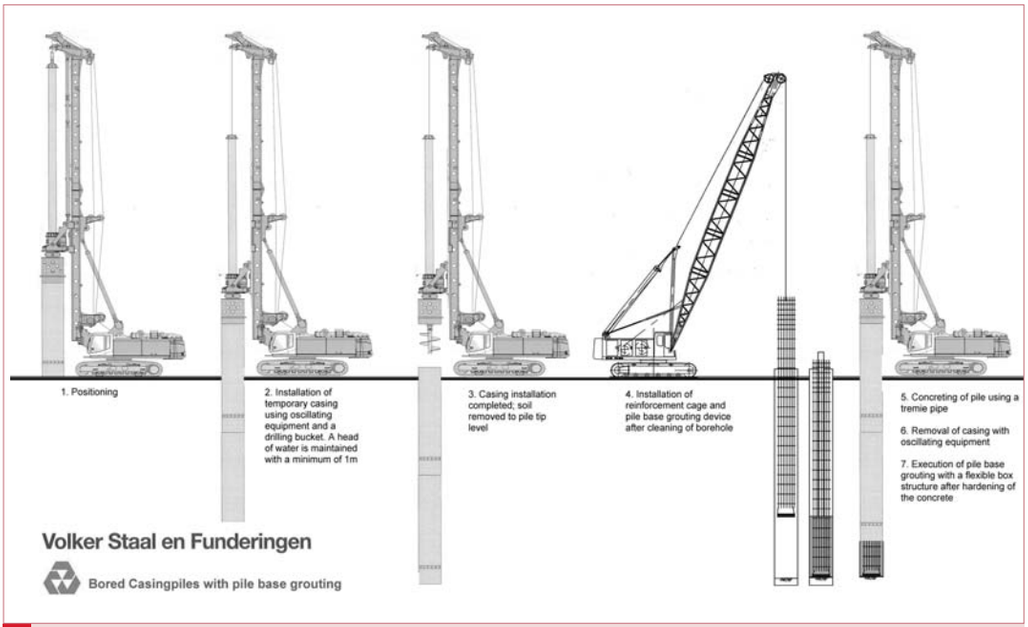

Figure 2 *Pile execution method.*

Figure 3 *Pile execution.*

Figure 4 *16 MN Statnamic load test.*

Cone Penetration Tests (CPTs) were carried out before and after excavation and again after installation of the piles. The piles where installed from a piling rig that was placed on a working platform on top of the sheet piles (*figure 4*). Six piles were monitored with strain gauges at different locations along the shaft. The continuous monitoring started directly after the underwater concrete was in place and lasted until most of the inner structure of the station was completed.

The pile design was based on the results of static load tests and on the results of Cone Penetration Tests (CPTs) carried out at various stages of the works. The performance of the piles was validated by monitoring results that were obtained during construction. Subsequently the results were interpreted to increase the understanding of the behaviour of pile groups subject to tension forces.
The choice for vibrated VM piles for this project proved to be an excellent one. Not only did the piles meet the construction requirements, the installation of the piles resulted in very limited noise and vibrations exposure to the surrounding municipal area.

Further information on both foundation techniques can be found in the conference proceedings.

Figure 5 *Piling rig.*

- Pile installation – vibration free/ leader driven/ conventional
- Supply and installation of associated temporary works

Through association with our sister companies VWS Geotechniek and Volker Staal en Funderingen in the Netherlands we can also offer other leading edge alternative foundation techniques including soil improvement and impermeable/ low permeability cut-off walls.

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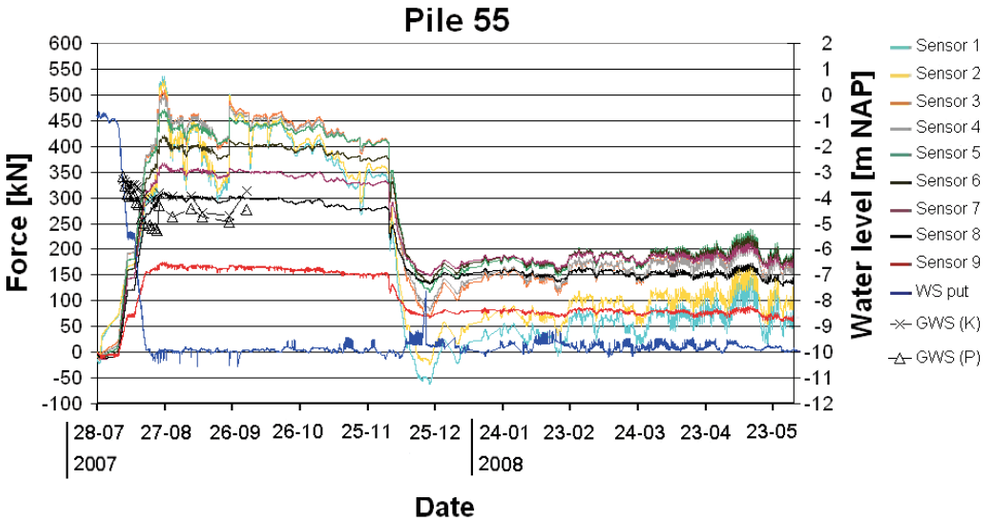

Figure 5 *Monitoring results pile shaft.*

Volker Staal en Funderingen

Volker Staal en Funderingen (VSF) is an innovative contractor in the Dutch foundation and steel fabrication industry, specialized in heavy and complex foundation techniques and steel structures.

VSF is a subsidiary of VolkerWessels and together with its mother company Van Hattum & Blankevoort, the infrastructural expert within the Volker Wessels group. VSF is located at the Quarantaineweg in the port area of Rotterdam, located directly at the Nieuwe Waterweg. VSF services a wide range of foundation techniques varying from piling to retaining walls and soil improvement. For more detailed information you are invited to visit our website or contact us directly. A few examples of our expertise and capabilities are presented here:

Waterworks

VSF has a great deal of in-house experience and expertise in floating piling techniques. Coupled with an extensive fleet of marine equipment including floating crane barges, VSF can provide a full projects service to clients including design, engineering and delivery in near or offshore waters.

Steel fabrication

Next to its office in Rotterdam, VSF has well equipped workshops, storage and assembly facilities for its steel fabrication business. A wide range of structures are constructed, welded and transported from these facilities including steel bridges, jettys, suction anchors, barges and mooring dolphins. The company's riverside location provides a wide range of transportation opportunities.

Pneumatic caissons and other air pressure techniques

VSF has more then 30 years of international experience sinking all kind of structures such as cellars, bridge foundations and TBM receiving structures. Ten years ago we expanded our scope for building underground structures with air pressure facilities. One of our present projects is the excavation and the concrete works at 25 m depth for the Underground station Ceintuurbaan in the North South line in Amsterdam. VSF has its own specialized equipment and expertise available for clients and other contracting companies.

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VWS Geotechniek

VWS Geotechniek is one of the leading Dutch engineering companies in the field of soil mechanics and foundation engineering. Moreover, it is the only company that connects theoretical knowledge directly to the know-how of construction.
The office is located near the city of Utrecht. Our work focuses mainly on the Netherlands, but designs and advice are also given on regular basis for international projects. Our project engineers and consultants are employed in an efficient and flexible way for our clients. Secondment to a project location is always a possibility.
Within the field of geotechnical engineering our scope is very wide. In our work we deal with almost every type of construction, technology and engineering method. By means of working at construction sites, contacts with contractors and participation in courses, committees, and international congresses, we continually raise our level of competence.

Based on a solid knowledge of theory as well as actual construction, we are able to advise about risks and problems during construction. Drawing up construction plans or quotations are also services we can offer.

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