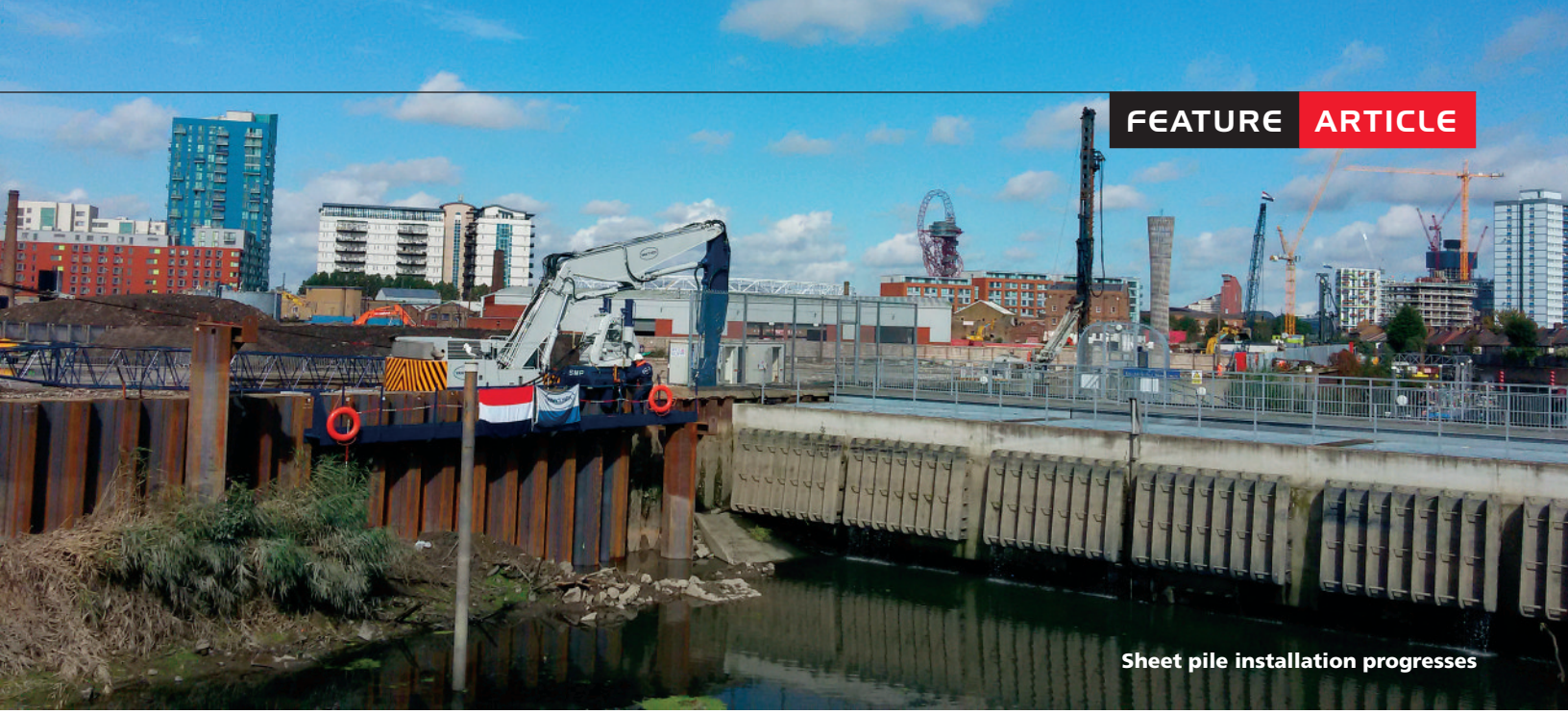


Sheet pile installation progresses

A New River Wall at Strand East

In September 2015, the Dutch piling company Van't Hek began the construction of a new river wall around Strand East in East London. Strand East is a 26 acre (0.1 sq km) former industrial area in Stratford, East London, close to the Olympic Village of the 2012 Olympic Games.

The site is enclosed by the River Lea, Three Mills Wall River (both influent of the River Thames) and the A118 (Stratford) High Street. Landmarks on site are the wooden tower in Dane's Yard on the bank of Three Mills Wall River and The Printhouse Pub and Restaurant. Along the banks of both rivers, the old river walls and embankments were replaced by a 1,045 m (3,428 ft) long stretch of new river wall. These new walls are part of the London flood defence system.

Van't Hek is a Dutch family-owned company that was founded 70 years ago right after the liberation of the Netherlands in 1945. It offers various pile systems, specializing in sheetpiling, and is a leader in Holland's deep foundations market. In 2011, the company expanded its business globally.

In February 2015, the bid tender was released for the UK NEC Design and Build contract. NEC is a family of contracts that facilitates the implementation of sound project management principles and practices as well as defining legal relationships. It helps to deliver projects on time and on budget and has become well known following its use for the London 2012 Olympic and Paralympic Games venues.

The first offer was made in March, and two dialogue sessions followed, in which a lot of 3D visualisation and BIM were used. At the beginning of April, the contract was awarded and the design process immediately commenced.

Design and Execution

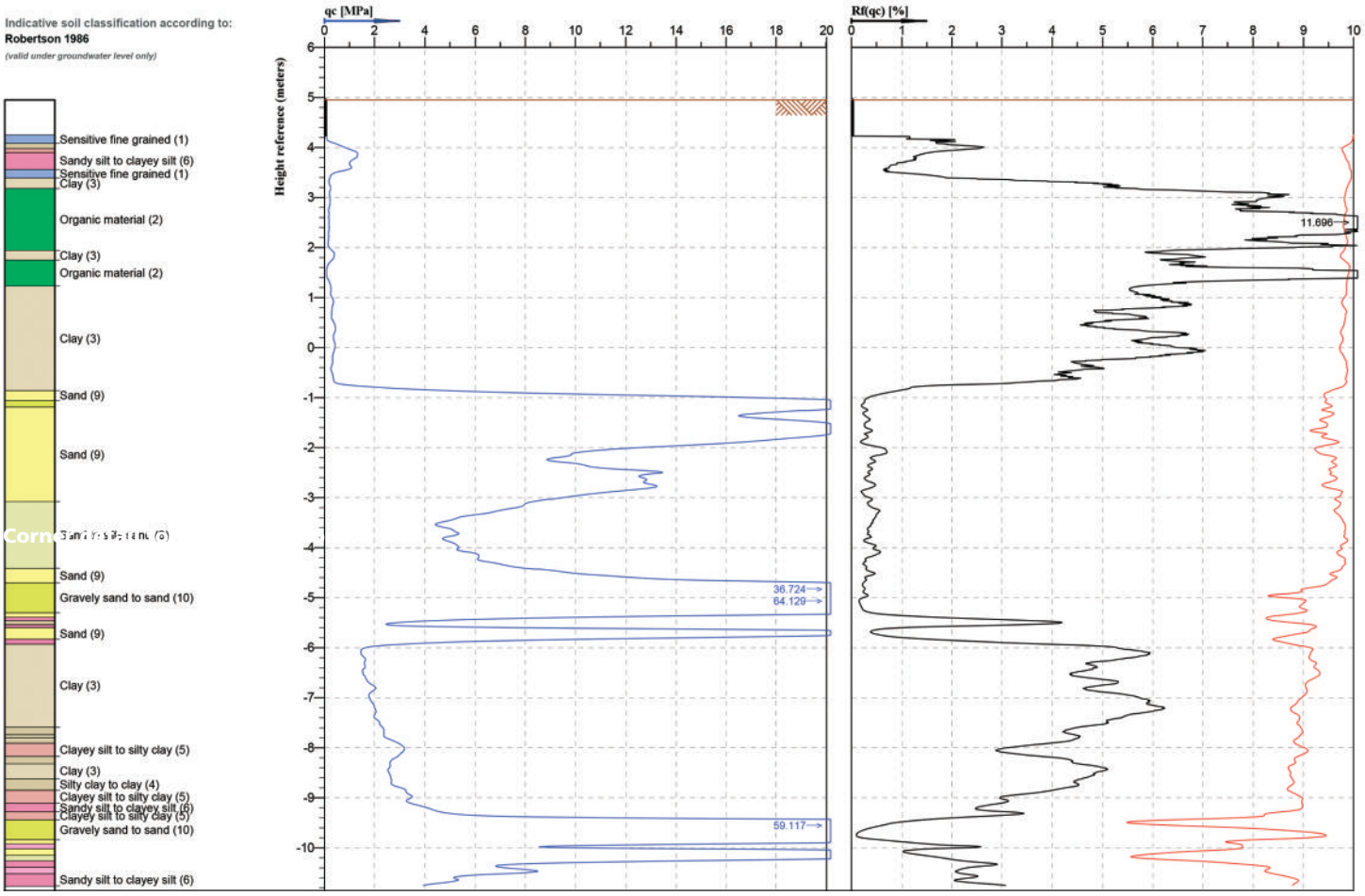
The client preferred a river wall built of cantilevered or tied-back steel sheet piles with a concrete capping beam on top and a 120-year design lifetime. Part of the construction was built as "online construction," which means that the existing structure is fully demolished or extracted while using a temporary cofferdam in the river to keep up the flood defence during the subsequent construction stages. After demolition, the new river wall was installed at the exact location of the old river wall. The remainder of the new river wall was installed by means of the "offline construction" method, which means it was installed about 1 m (3.3 ft) in front of the existing structure. The average retaining height of the new river wall is between 3.5 and 5.5 m (11.5 and 18 ft) and the sheet piles extend up to 2.7 m (8.9 ft) above the water.

Since the existing river wall and now the new river wall are part of the London flood defence, the construction could never have a top level Above Ordnance Datum (AOD) elevation +5.50 m during the construction phase. The design provided for a rise of the flood defence level in the future to AOD +6.20 m in tidal areas.

Standards and Codes

While quickly performing the tender design in just one month, challenges were encountered because of the difference in standards and codes used in the U.K. and the Netherlands. Although both countries use the Eurocodes, there are still differences in the respective National Annexes that refer to other national guidelines for river wall construction. In the Netherlands, working with the Dutch Cur 166 is common whereas in the U.K., designers use Ciria C580 during the final design phase. Also the B42/00 for road design

AUTHOR *Patrick IJnsen, Managing Director, Hektec BV*



Results of CPT on site

was used to find the correct load combination for the road directly behind the new river wall, and the impact actions on railings and the portion of the capping beam that acts as a roadside barrier. The whole design was also verified for compliance with the new CDM 2015 to check safety of the construction during execution and services stages.

During the design phase, the client's advisors, U.K.-based Peter Brett Associates and BWB Consulting, cooperated with Van't Hek's engineering agency, Hektec, which was responsible for the full river wall design and for fitting the river wall design into plan for the entire Strand East area. The client hired a geotechnical expert, Crux Engineering, also from the Netherlands, to check the design as it evolved. Bureau Veritas also reviewed the process on behalf of the insurance company where Peter Brett Associates performed the third-party check after the design was finalized.

Soil Conditions

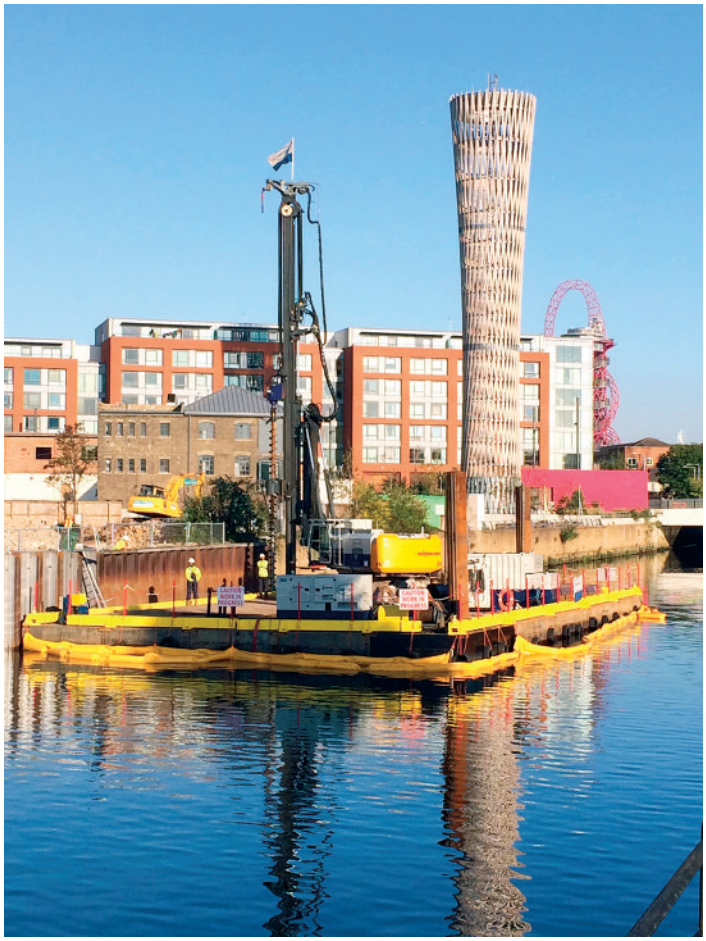
Although many borehole logs were available, many did not have SPT values on them, however there were triaxial test results on undisturbed soil samples and grain distributions of the sandy layer better known as the "river terrace." So it was possible for the Dutch engineers, who are more accustomed to CPT-based design and had little experience with London soil conditions, to understand the soil conditions to base their design on. The final design was based on soil parameters obtained from British geotechnical literature, which were verified directly after the contract was awarded using CPT testing. It was performed on site by BMNED, the Dutch partner of Van't Hek.

The river terrace layer dictated the design of the new river wall. This soil layer is found 4 to 6 m (13 to 19.7 ft) below the projected surface level behind the new river wall of AOD +5.5 m. It contains sand, gravel and cobbles and lies beneath a clayey alluvium layer. At the top is "made ground" or urban fill — a landfill that gives a good overview of everything that happened on the site after the first industrial revolution; however it has no engineering value. Therefore, an anchored sheet pile wall was required to meet both strength and deformation design criteria. The design toe level of the sheet piles was dependent on the cross section but had to be a least 1 m (3.3 ft) into the river terrace layer, which was not easy to penetrate due to its dense formation.

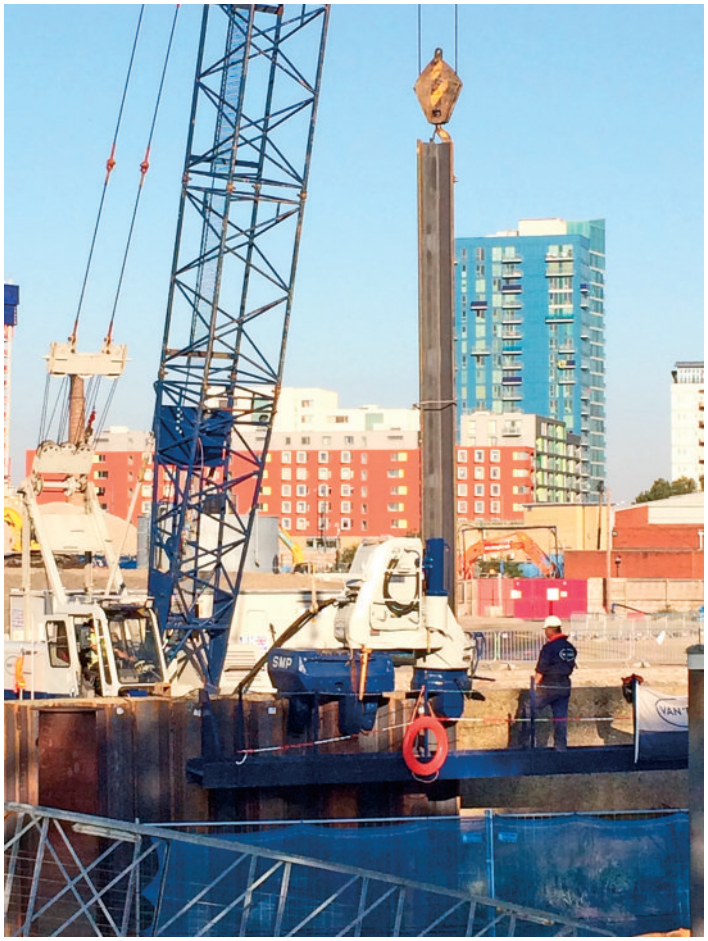
Sheet Pile Installation

It was preferable to drive the sheet piles with a vibratory hammer, however due to the different legal setup in the U.K., where it is not possible to share any responsibility with the client or authorities, the contractor opted to use vibration-free pressing of the sheet piles as the main installation method. A specialty subcontractor was hired to install the anchors using sonic drilling.

Design requirements including durability and design toe level required a robust type of sheet pile with a thick wall. Since the existing embankments varied in surface elevation and the water level was tidal, the permanent sheet piles that were part of the existing



Installing sheet piles from a barge



Picking the sheet piles for installation

View from the land side of the seawall

river wall were installed by means of a Silent Piler manufactured by Giken. To meet all requirements a sheet pile type Larssen L24 12/12 with a length of 12 m (39 ft) was chosen. This is a U-shaped sheet pile with a single pile section width of 500 mm (19.7 in).

Due to the small width, shaft friction and toe resistance during installation were minimal. The sheet pile's thick wall together with the robust U-shape reduced the risk of buckling and deformation during installation. The thickness was also required to meet corrosion requirements in the aggressive conditions caused by both the potentially contaminated industrial soil and the marine conditions. The temporary cofferdam sheet piles were installed as quadruplets — four interlocking sections — using a leader mounted on an ABI silent pressing system placed on a coupled container pontoon working from the river side.

Anchor Design

The challenge for the anchor design was again the river terrace layer, which in certain areas was limited in thickness. High5Solutions (H5S), the specialty subcontractor for the anchors, performed in-situ tests on its new sonic disk anchor system immediately after the project began. A single 400 mm (15.7 in) diameter disk anchor met the design anchor capacity requirements and was successful. With this anchor system it is possible to reach comparable installation depths to conventional grouted anchors while using little drill mud and grout. In the anchor design, both anchor disk and GEWI threadbar have a sacrificial thickness to meet corrosion requirements for a 120-year design life. Approximately 750 anchors were installed. The final elements in the construction program for the new river wall was the capping beam on top of the sheet pile wall. To meet the requirements of a 120-year design life and uniformity in appearance along the whole perimeter of the site, the contractor used prefabricated concrete capping beam elements mounted on a steel plate that was welded on top of the new sheet pile wall. All element dimensions were measured after installation of the steel plate to ensure a flawless installation of the elements.

Modelling and Closing

Since the client required that its design be delivered in a 3D Revit model, BIM site management was implemented on the project. With this information management system it is possible to record progress and installation data to the 3D model in the BIM system. At the end of the project, the contractor delivered an as-built model with all cutting heights, installation toe levels, anchor test reports and deviations.

Van't Hek is now working on behalf of the client in close cooperation with its advisors (PBA and Brydenwood) in the interdisciplinary design team that is responsible for both future infrastructure and buildings on Strand East. There is additional work on the road, building and foundation design in order to optimize future costs of the buildings on site.

Silent Piler with quadruplet sheet piles

Preparing sheet piles for installation