

Cementation

SKANSKA

Further information:
Cementation Skanska
skanska.co.uk/cementation
cementation@skanska.co.uk

21 Moorfields

Location:
London

Post Code:
EC2Y 9DP



Value:
£12.1 million

Duration:
52 weeks

Completion Date:
November 2018

Client:
Mace

PC:
Sir Robert McAlpine

Engineer:
Robert Bird Group

Scope of Works:
1nr preliminary test pile
5nr existing pile removal
15nr 1200mm diameter bearing piles
4nr 1800mm diameter bearing piles
11nr 2400mm diameter bearing piles

Press coverage:
<https://www.building.co.uk/buildings/over-the-line-how-21-moorfields-was-built-above-a-station/5098795.article>

https://awards.geplus.co.uk/2019_winners



Scope

21 Moorfields is a new headquarters building spanning 50m across part of Moorgate Station in the heart of the City of London. The foundations scheme comprised 11no. 2.4m diameter bearing piles, 4no. 1.8m diameter bearing piles and 1no. 1.2m diameter sacrificial test pile. A 200t test frame was constructed above the test and reaction piles in order to achieve the required 50MN maximum test load, believed to be the maximum top-down static load ever applied to a pile in the UK.

The test pile and reaction piles were instrumented with fibre optics and strain gauges at multiple levels. All piles were 58-60 deep, constructed under bentonite and base grouted post-construction.

Collaborative working

The location and characteristics of the 21 Moorfields site required highly integrated and collaborative working to allow the station to remain open throughout construction and also to ensure that each pile was constructed to the specification, right first time. There was zero margin for error as any defective work would have resulted in significant re-design of the building structure. Through close working with the client Mace,

Engineer Robert Bird Group and specialist sub-consultant Geotechnical Consulting Group, a risk sharing and management approach was developed to ensure that all design and construction risks were minimised and managed collaboratively by those parties best able to do so.

Innovation

Working above a live underground station presented several challenges for the project team. The 120t piling rig was transported and lifted into the site using a specialist self-propelled modular transporter (SPMT), manoeuvring through narrow streets, and delivering the rig to the temporary steel working platform 2m above street level.

All spoil had to be removed via a purpose-built spin off skip which prevented loose material from falling onto the retained deck (the Moorgate underground station roof). In addition to this any excess bentonite produced during the concreting operation had to be removed from the bore without overflowing into the station. To achieve this a bailing tool was designed which attached to the piling rig. It was constructed so that excess bentonite and concrete could be removed safely without affecting station operations.

Due to the uncertainty in the Thanet Sand level and the requirement to embed all piles 2m into the Thanet Sand the reinforcement cages were designed to be adjustable on site with loose extension pieces and designed cut points. This variable cage length design proved invaluable when the Thanet Sand was encountered slightly deeper in the NW corner of the site.

CemOptics, Cementation's patented system of thermal integrity testing was installed in all of the piles on the Moorfields project. This uses distributed fibre optic sensing (DFOS) to monitor the heat produced by the concrete as it hydrates. Once complete, the results are analysed and an assessment of the integrity of the concrete is made. Additionally, DFOS were used during the pile test to measure the distribution of strain within the test and reaction piles. Alongside traditional vibrating wire type strain gauges this produced a complete profile of the pile's performance and allowed the project's designers to understand its performance in detail. In total, over 14km of fibre optic cable was installed in the piles at 21 Moorfields. This will allow measurement of the piles' performance to continue during the life of the structure and give the scheme designers an unprecedented understanding of its behaviour.

All of the piles at 21 Moorfields were base grouted. This required additional instrumentation to verify the effectiveness of the grout injections. Pile base displacements and strains were measured using extensometers, vibrating wire strain gauges and DFOS.

GE Awards 2019

Excellence for their work at 21 Moorfields where they installed the UK's highest load bearing piles to support the construction of a new office development above Moorgate tube station.

The judges commented; "A thoroughly deserving winner. The judges were particularly impressed by Cementation's willingness to undertake research and development at its own cost during pile testing to investigate the performance of the pile during base grouting. This project will provide invaluable information to the industry for future large diameter, deep piling projects."

The 21 Moorfields team also picked up an award for UK Geotechnical Team of the Year for their work alongside Robert Bird Group, GCG, Mace and Byrne Looby.

The judges said the team's collaborative approach ensured risk sat with the correct party and helped to deliver the innovative temporary works for the test pile. "The no blame culture was very evident in the presentation, along with the team's flexible approach and openness," said one judge.

Another added; "The team all understood the real consequences if things had gone wrong."



Client Feedback

Mark Jackson, Associate Director said "From Cementation's first involvement at the very early stages of design, their team have been very cooperative and professional in their approach to the project. It was a very high risk project with only 15no permanent piles designed to provide the foundations of the future main build. The design and installation of the highest loaded piles to date in the UK also required a successful pile test before piling could be completed on site. With pile installation also being directly above the "live" Moorgate London Underground station, a unique temporary steel grillage was required as a piling platform and introduced further unusual logistical problems to solve such as managing the risks to the station, and the delivery of the piling rig and attendant crawler crane by SPMT.

Despite the high risk nature of the project, Cementation successfully planned, managed and mitigated the risks throughout. Their collaborative and innovative approach with the whole 21 Moorfields project team enabled their works to be successfully delivered and completed two months early on site."

