

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

# Northwick Park

## Stabilisation of the Metropolitan Line

**Client**  
Metronet

**Main Contractor**  
Cementation Skanska

**Engineer**  
Mott MacDonald

Work was completed on essential stabilisation works on an ageing earth structure for Metronet between Northwick Park and Preston Road Underground Stations on London Underground's (LU) Metropolitan Line.

The contract with Metronet was awarded to Cementation Skanska for the design and construction of stabilisation measures to the 6m high southbound embankment over a length of 1,200m.

The embankment was originally constructed by the Metropolitan Railway and opened in 1880. The line was initially opened with two tracks and gradually widened to six tracks. By 1935, the surrounding area had been developed from farmland into a residential area and space at the toe of the embankment was limited, as a result, the upper slopes were over steepened to allow room for the railway to develop.

The Metropolitan Line at this location required regular maintenance by Metronet to maintain the safe running of trains. Due to ongoing settlement of the embankment and lateral displacement of the lineside services, an intensive monitoring regime and a temporary speed restriction were imposed on the line. Undermining of the lineside services had resulted in significant leaning of the cable posts away from the track. The contract required the line to remain open throughout the construction of the works, which were designed for a life of 120 years with minimal maintenance. Cementation designed the works in partnership with their designers, Mott MacDonald. The design addressed both the shoulder stability and deep seated failure mechanisms throughout the length of the embankment.

Early contractor involvement enabled the project team to secure a full road closure of Windermere Avenue to provide plant access to the embankments. The site was otherwise landlocked and securing the road closure was essential to enable the works to be completed in a fast track manner to secure the lifting of the temporary speed



restriction on time. Several external stakeholders were involved by the project team with the negotiations including, the London Borough of Brent, the Police, London Transport Buses and the Local Residents Association. The road closure was granted but only for a 6 month period.

Before access could be made onto the embankments a number of new cable posts were strategically installed along the lineside services to provide temporary support. Access platforms were then constructed along the entire length of the embankments to allow Cementation's specialist plant access to the embankments.

From the earthworks platform temporary cuts were made into the crest of the embankment. The cuts were supported using a combination of anchored and cantilever retaining systems. The running rails of the Metropolitan Line were monitored during engineering hours on a weekly basis throughout the project and the temporary works were monitored on a daily basis to ensure that the stability of the track was not compromised.

The earthworks platform also enabled vertical and inclined bored piles to be constructed with LU approved plant. Each pile was constructed through the embankment fill material and into the underlying London Clay, pinning potential slip planes. A total of 4,500m of 308mm diameter vertical piles and 1,900m of inclined piles were constructed. Pile cages were installed in small sections to enable all of the piling works to be carried out during normal traffic hours.

The crest wall was constructed using Cementation's CemRailBeam® system. The precast units were placed with 13T excavators whilst the piling works continued. The toe wall was located within a very narrow corridor of embankment and required placement with specialist plant from a narrow walkway approximately 1.5m wide.

The CemRailBeam® is a unique reinforced capping beam system designed by Cementation to overcome safety, quality and production difficulties on traditional embankment stabilisation works. It involves factory-made pre-cast shuttering units placed over the piles, combined with reinforcement and concrete to form a continuous trackside retaining wall. The capping beam constructed in this manner significantly reduced the temporary works requirements and in particular the depth of temporary excavations when compared to traditional cast in situ methodology. The capping beam was then fitted with a two bar handrail.

On completion of the capping beam works, engineering fill material was placed behind the capping beam to support the crest of the railway and to provide safe walking routes for railway personnel. Down slope of the capping beam, the slope was locally regraded to suit the existing site geometry in order to improve the factor of safety for down slope stability. Where necessary material was removed from the slope and granular material imported to create a smooth slope profile.

The final interface between the track and the stabilisation works involved placing additional track ballast trackside of the lineside services.



The earthworks sections involved a net import/export of up to 400m<sup>3</sup> per day. Delivery vehicles were strategically scheduled throughout the works to deliver materials and remove muck away in a just in time process. This minimised the number of deliveries through the residential area and was a necessity as only limited storage facilities were available on Windermere Avenue.

We had worked 40,000 man hours and have had no reportable accidents. The experienced project team successfully completed the project ahead of programme which enabled the early lifting of the temporary speed restriction and the reopening of the road closure four weeks ahead of the contract programme.

During the works, the project team found time to improve the conditions under the railway bridge sited within the road closure. This included improved lighting underneath the railway bridge, providing access to Thames Water to update the drainage systems, repainting of the railway bridge structure, and placing pigeon guano netting to the underside of the bridge to provide an improved environment for the local residents.