

Cementation

SKANSKA

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The Jubilee Line Extension, London

Client

London Underground

Main Contractor

Tarmac Construction

JV Partners

Cementation Skanska
Bachy Soletanche

Scope of Works

- Instrumentation
- Monitoring
- Compensation Grouting



The Jubilee Line Extension is a major addition to London's underground rail network. Contract 101 comprises passenger interchange tunnels plus access, escape and ventilation shafts. The interchange tunnels join two major lines at concourse level. This section of the development is located beneath many historic buildings in affluent Piccadilly.

The main contract was awarded to Tarmac Construction Limited, for a total value of £11m. A subcontract valued at £2.4m was awarded to Bachy-Cementation Joint Venture for a monitoring and compensation grouting scheme to protect buildings from damage due to tunnelling.

Instrumentation and grouting results were integrated on a central computer network. Most information was available in real time and could

be analysed and presented in a number of formats. Predetermined alarm levels triggered automatic audible and visual alarms and automatic dialling for pagers ensured contact when the site was unoccupied.

Grouting instructions were sent electronically to the integrated grouting unit through the network. Injection grouting was computer controlled and recorded using Bachy's SPHINX and EPICEA systems.

Design and analysis of the compensation grouting was carried out using a 3-dimensional model of the works (with overlying structures) and a representation of the progress of the tunnels. All the factual records were shared with the main contractor and client electronically.

Monitoring

A network of precise level points was installed in the roads, walkways and buildings. They were surveyed daily in areas of active tunnelling using a digital level that could be downloaded directly onto computer.

Electrolevel sensors were positioned parallel and perpendicular to the settlement trough axis, in every structure likely to be affected. These detected vertical movements as small as 0.1mm and were read automatically every 15 seconds if necessary. In-Ground movements were detected both by electrolevel sensors installed in subsurface subhorizontal holes and by extensometers in vertical boreholes around the site.

Grouting

Loss of ground due to tunnelling can cause surface settlement and structural damage. The philosophy of compensation grouting is to replace losses before they cause surface or structural movement.

Small quantities of grout (as small as 25 litres in selected sleeves) were injected into the ground between the building foundations and the top of the tunnels.

Two arrays of subhorizontal holes were drilled to install tube-a-manchettes pipes that allowed repeated injections at any one location.

This meant that any number of controlled injections could be made into areas where settlement was predicted or had occurred.

Compensation grouting proved its worth on JLE contracts but can only be successful if allied to modern data retrieval and control systems. Cementation Skanska are currently and constantly upgrading these works systems on complicated deep basement and tunnelling.

