

C511 Whitechapel Station Upgrade



Extremely tight working spaces and limited access points made this project a complicated logistical puzzle. On Cambridge Heath Shaft Bauer installed a circular shaped diaphragm wall, by incorporating wedge shaped sacrificial pre-cast stop ends at the joint of each panel.

At Durward Street's more conventional straight lined station box, Bauer designed a new type of steel stop end which allows easy removal even at great depth (in this case up to 36m).

With a combination of the 30m depth of the Crossrail tunnels and the number of horizontal break-throughs required into the two shafts, both diaphragm walls will be exposed to extreme loadings, including biaxial bending forces.

In order to control these forces, the design required the maximum permissible density of reinforcement to be included in every panel. In reality this

meant providing up to 525kg of reinforcement per square meter of exposed diaphragm wall. As the minimum clear bar spacing had already been used throughout the cages, sonic logging reservation tubes had to be used as a structural element for limitation of crack widths in certain parts of the cage. Accumulated construction tolerances left a theoretical reinforcement cage clearance between stop-end and reinforcement cage at the panel toe level of only 18mm.

Bauer utilised two different stop end systems to form interlocking waterproof joints between diaphragm wall panels. The circular shape of the Cambridge Heath Shaft required the use of tapered permanent precast stop ends whilst the straight joints of Durward Street could be formed with the new Bauer Type C removable stop ends placed to depths of 36m. During the initial development stages, it became apparent that not

just the excavation tolerances had to achieve 1:225 but all other processes had to be optimised to allow the maximum rebar density to be installed into the highly stressed shafts. This required innovative hanging and straightening devices to be designed and manufactured by Bauer in order to achieve a stop end verticality of 1:300.

Connection of the complex reinforcement cages and the placement of the large concrete volumes required for each panel was a major challenge within normal working hours. Together with the main contractor, a BAM Nuttall Kier JV, Bauer worked closely with the local council to gain approval of extended working hours (after 6pm) with minimal impact to local residents.

The fabrication of the reinforcement cages was further complicated by the requirement of numerous slab coupler U-bars to be installed into the tight matrix of longitudinal and horizontal

steel. Furthermore, all tunnel break throughs required installation of trim bars in order to prevent the diaphragm wall at tunnel crown and invert level from deformation upon demolition of the sections concerned.

Together with the reinforcement supplier, Bauer incorporated all the design requirements successfully. The team also produced a complex suite of temporary works designs in order to safely lift each reinforcement cage (including corner and T-shaped cages up to 61tons).

In addition to complex reinforcement cages and to ensure that both materials worked well together under these circumstances, a concrete mix was designed by Bauer Technologies in close collaboration with the concrete supplier. Particular attention was given to ensuring good flow and workability characteristics. This workability was put to the test when a delay during the installation of one reinforcement cage resulted in concrete trucks holding their loads for 4.5hours after which the flow properties were still well within the limits dictated by the European Standard.



Client:

Crossrail

Principal Contractor:

Barn Nuttall/Kier JV

Piling Contractor:

BAUER Technologies Limited

Contract Period:

October 2011 - May 2013

Project Value:

£16 million

Bauer's Scope of Works:

- Removal of obstructions using rotary piling equipment
- Installation of guide walls
- Installation of 13,000m² diaphragm walls and barrettes (two shafts) up to 51m depth

Equipment Used:

- HS875 grab crane with BAUER DHG-C hydraulic grab unit (3200x1200mm)
- MC64 grab crane with BAUER DHG-B hydraulic grab unit (3200x1500mm)
- BAUER temporary steel stop ends type 'C'
- Precast stop ends