Bloomberg Place, Queen Victoria Street, London

Innovative logistics, extensive off-site prefabrication and careful co-ordination feature in the concrete works of a new headquarters under construction in the heart of the City of London. ***Bob Lloyd*** *from* ***Byrne Bros*** *explains how the challenge was tackled.*

One of the logistic loading platforms.

Above: Temporary king posts, installed by McGee/ Cementation (Skanska) supporting existing/road structure.

Top left: New basement liner wall in front of retained structure and a slab rather than capping beam. This slab was also part of the early logistics scheme and was referred to as SMART 2.2 slab. Slab at ground-floor level.

At 6am one spring Saturday during 2014, four pumps began pouring 1800m^3 of concrete to form the Level 3 basement (B3) raft of Bloomberg's new London HQ. Packed into a triangular-shaped 1000m^2 area was more than 600 tonnes of reinforcement and by 9pm that day Byrne Bros had successfully completed what, at the time, was the largest single concrete pour to take place in the City of London.

Designed by architect Foster + Partners, the 71,000m^2 scheme comprises two triangular-shaped, ten-storey buildings separated by a covered arcade. Above ground, bridges span the arcade to link the two buildings; below ground, a giant double- and triple-height basement, which includes the B3 slab at its centre, unites the two buildings. In its north-east corner, the concrete basement is set into the ground still further to house a new entrance to Bank Underground Station.

Byrne Bros' task was to construct the basement box, raft foundation, ground-floor slab and various intermediate floors within that box. The contract also included construction of the building's seven slipformed concrete cores and six jumpformed shear walls, all of which had to be completed early in the programme to enable construction of the building's steel superstructure to commence.

Sequencing the concrete works was a major challenge and to keep the project moving, an innovative logistics solution was developed by constructing four sections of permanent works at ground floor and transforming them into loading/unloading bays.

The bays were strategically positioned around the site and allowed work to commence on the basement's retaining walls without interfering with the basement dig, piling teams and ground workers.

An early task was the construction of the heavily reinforced capping beams that formed the basement perimeter along Walbrook. Access space here was very limited, so Byrne Bros manufactured the beam reinforcement in sections at its prefabrication facility in south London. The preassembled reinforcement bar sections were then delivered in the required sequence, with unloading slings preattached ready for lifting into place on arrival.

A walkway was designed through the middle of the reinforcement cages to allow fixers access from the inside, which meant there was no need for operatives to work from the outside, greatly improving safety and speeding up installation work.

> "Instead of digging down, propping the excavation and then building up from the basement raft, the core was built on a series of columns and whatever walls were necessary structurally to support the slipform rig."

Reinforcement links over the three main piles were fixed loose and intermittent access points were provided along the beam. Two vertical lapping U-bars were then installed to allow access and an inverted top section was tied to the vertical legs of the bottom link. The top U-bar and internal links were the last elements to be fixed after all the longitudinal bars had been threaded through the beam.

Capping beam

On the section of the capping beam adjacent to the new underground station entrance, the structural design for the capping beam required some of the longitudinal reinforcement to pass through the king posts projecting from the secant pile retaining wall and some reinforced corbels were needed on the inside face of the beam

Pour for the B3 slab.

to support temporary raking props. For this element, a hybrid design of loose fix and prefabricated reinforcement was chosen, most of which was installed from the adjacent loading bay platforms.

The basement columns were mostly prefabricated off-site. Each of the 345 column types had a separate detail and reinforcement specification, and varied in height to accommodate a 1m level difference across the site.

To avoid reinforcing layers clashing as the level changed, careful co-ordination was necessary to make the slab/fold interfaces work. The task was made all the more complicated because the reinforcement was orientated orthogonal to the sloping face of the building on the Queen Victoria Street elevation.

Tolerances

Tolerances in the concrete covering reinforcement had to be within 5mm, rather than the usual 10mm *National Structural Concrete Specification*[1]. The mix specification included a 100% recycled coarse aggregate and high levels of GGBS. To achieve the correct consistence, BASF Glenium C315 plasticiser was used throughout the project.

A top-down approach was used to construct the basement box, to enable the core slipform rig for this area to progress up the building, while the structural box beneath was still being completed. Instead of digging down, propping the excavation and then building up from the basement raft, the core was built on a series of columns and whatever walls were necessary structurally to support the slipform rig.

One of the key challenges with construction of the seven slipformed cores was the co-ordination of cast-in inserts, including embedment plates and cast-in channels from four different contractors, some of which weighed as much as 750kg. Embedment plates to support the façade were incorporated into the cores at each floor level. These were two-sided, to enable them to be fixed together within the wall, with large shear blocks and bolts tying the two plates together.

Reinforced concrete shear walls, 7m long and 600mm thick, rise from the basement raft to the roof, ten storeys up. As these walls were such slender structures, they needed to be laterally restrained by tying them back to the cores at ground, second, fourth and sixth floors during their construction.

Rather than install temporary steel bracing, which would have had to be removed later in the programme and replaced by permanent steels, Byrne Bros worked with the structural steelwork contractor to advance the erection of the permanent steel members adjacent to the shear walls, to simplify construction.

With the cores completed, the shear walls in place and the reinforced concrete ground-floor slab finished, the steel erector could commence installation of the main superstructure. The steel-framed superstructure has nine floors (ten storeys) of concrete on metal decking.

Byrne Bros' work is all but complete and the iconic new building is set to open in summer 2017. ■

Reference:

1. CONSTRUCT. *National Structural Concrete Specification*. Fourth edition, The Concrete Centre, Camberley, 2010.

Key project statistics

Total concrete poured	60,000m^3
Reinforcement	11,000 tonnes
Peak day labour force	310 operatives
Threaded reinforcement bars with couplers	300,000