

Bank Underground Station Capacity Upgrade (BSCU)



Dragados/ London Underground Ltd



Bank Underground Station



June 2014 to November 2017



£5.7m



Capacity Upgrade (BSCU)

Introduction

To support its network capacity upgrade, London Underground is undertaking a major capital project to expand Bank underground station. This £642m scheme will improve the capacity of Bank station, and reduce journey times and congestion in the Northern Line, Central Line, Docklands Light Railway (DLR) and interchange areas within the Bank-Monument station complex.

The Bank and Monument Tube station complex is located in the heart of the City of London financial district and is the fourth busiest interchange station on the Underground network with 96,000 passengers during the morning rush hours (1.17 billion passengers a year), which is set to increase by 40%.

Bank is served by six lines (Northern, Central, Waterloo & City, and at the Monument end of the same station

complex, the District and Circle, as well as DLR, for which Bank is the main central London terminus. The disused King William Street Station lies to the south of the site.

The project will be delivered under the heart of the City of London, one of the most expensive areas of real estate in the world while the station remains operational and with minimum impact on adjacent structures and the City's everyday life. The works involve specialist tunnelling, civil engineering, high voltage power engineering, communications systems, lift and escalator works, as well as building and M&E work.

Key elements of the works include:s

- New station entrance in Cannon Street
- Three ticket halls
- Six lifts
- 10 platforms
- 15 escalators
- Two 94m travellers



- New 570m tunnel and platform for the southbound Northern Line.
- A step-free route between the Northern Line platforms, DLR and street levels.

Other partners that have been involved in the scheme include:

- Wilkinson Eyre Architects – architecture and design contract for station upgrade.
- Robert Bird Group – structural engineers.
- Fairhurst – temporary
- Works designers. (Appointed directly by Cleshar).
- Dr Sauer Group – tunnelling engineers.
- T. Clarke – M&E Engineers (design and installation).

The project will complete in 2022.

The Bank Station capacity upgrade project has benefited from London Underground’s pioneering use of the **Innovative Contractor Engagement (ICE)** procurement process

which was designed to select the best principal contractor (Dragados was appointed in 2013) and supply chain, including Cleshar, and to incentivise innovation, placing value at the core of the project from the outset.

BCSU’s customer team conceived and developed ICE to ensure that all good and relevant ideas proposed during bidding were rewarded, developed and implemented in the project. All the teams involved in this process were actively engaged throughout the design process, leading to the optimum solutions that were ‘Best for Bank’. The successful execution of ICE on Bank Station has provided London Underground with a platform for future development which addresses the historic challenge of how to control costs, accelerate the works and reduce the impact on the travelling public.

Works were carried out in overlapping phases by Cleshar, and included:

PHASE 1: Early Contractor Involvement (ECI), June 2014 to January 2016

As part of the ECI stage, Cleshar was involved in carrying out extensive intrusive survey work, checking structures, foundations and ground conditions in order to de-risk the construction phase. Cleshar also managed light civils works and contributed to the design development of the station civils and premises packages and new Northern Line southbound slab track installation.

Other elements included buildability, noise and vibration (as the main works are taking place underneath a conservation area, including many major, historic and listed buildings), logistics, possessions and programme.

St Mary Abchurch is one such building and Cleshar was responsible for installing the necessary temporary works and scaffolding in the church so that others could complete the specialist survey work on wall-mounted paintings/historic artefacts.



PHASE 2: Staff locker room and welfare facilities, December 2015 to November 2016

Cleshar demolished the existing staff accommodation (to provide the space for the installation of new HV and LV rooms) and built new state-of-the-art facilities for 80 station staff, including managing the migration of staff into this new accommodation.

PHASE 3: HV migration, April 2016 to November 2017

This phase of the works involved a number of complex work elements, which included:

Access platforms and HV cable routes within disused tunnel shaft

Cleshar was responsible for demolishing 24no. bay slabs at high level within the existing disused back-of-house tunnel shaft (2/791) to form new openings to the floor slabs above. This required complex staged temporary works for access. New large steel access platforms were then installed to accommodate the HV cable routes.

New trenches were excavated and cast in situ in close proximity to live trunk sewers, which required an initial in-depth review of the service drawings and subsequent safety critical confined space working, using winches to carry out the works.

LV void steel access platform

This element of the works involved the installation of a new 90m² steel platform supported from the ceiling and walls directly above the Central Line escalators. This required the installation of a large, unique three-tier 120m² temporary crash deck

suspended above the live escalators. 6000kg of structural and architectural steel was used to form this new steel structure, which then became the new 90-minute fire-rated room.

All installation works were undertaken within possessions and all lifting and installation operations were completed without damage to the escalators or existing assets, and without impact on the operational railway (despite working within touching distance of both).

Some remedial work was required to the existing steelwork (repair to the beams) as well as some additional bespoke design to accommodate other non-conformances in the form of some old bent steel beams as a result of the impact of a World War II bomb.

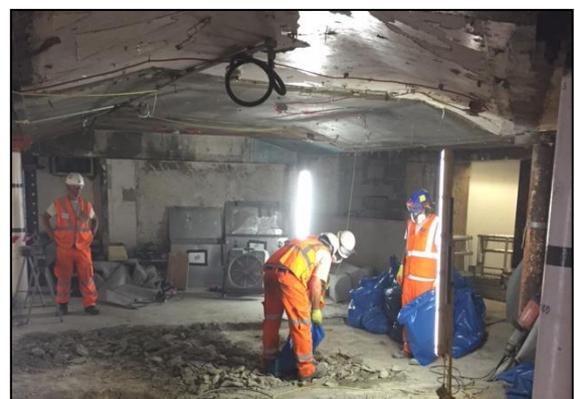
New HV and LV rooms for Central Line power upgrade

New large blast proof HV and LV rooms for the Central Line power upgrade were built within the space vacated by the old staff accommodation (and station supervisor's office). The works consisted of:

- Erection of fireproof hoardings as part of the site set up
- Demolition and strip out of the internal rooms
- Removal of the existing structural screed in all areas and the installation of new
- Coring 800mm station walls (requiring staged and complex temporary

works/metal propping as they are located directly beneath the intersection of roads above) to facilitate the installation of entrance doors and large openings (for the ventilation ducts)

- Coring floor slots and access openings between rooms for new HV/LV cable routes
- Formation of new concrete encasements around existing support beams
- Installation of blast proof new block walls and wind posts to create new rooms
- Installation of SR1 and SR2 fire doors and fire compartment rooms
- Floor, wall and ceiling painting
- Finishes and tiling work throughout.



Pipe subway/enabling works for Dragados' tunnel teams

These enabling works focused primarily on fire safety management comprising the installation of 100m of temporary fire-rated trackside and non-trackside hoarding, coring works, room segregation and back-of-house tunnel segregations, as well as the design and procurement of new fire premises related items, e.g. doors, fire cabinets, condensers cages, etc. The trackside fire hoarding enabled the safe

storage of heavy duty compressors.

Much of this work was carried out in close proximity to high risk confined working and gas line areas, requiring the use of specialist/safe working tools and procedures. Of the above works, approximately £300k worth was made up of temporary works.

OUR DELIVERY TEAM

Cleshar's team of nine management staff was co-located with Dragados' team on site. A workforce of 20 was deployed on the works during the day, increasing to 30 on the night shift.

Cleshar also provided handback personnel (T002/3) on a call-off basis.

CHALLENGES

- **Operational station:** Undertaking 24/7 highly complex works within one of London Underground's busiest stations presented its challenges at Bank, key of which was minimising the impact of the works on day-to-day operations and the travelling public, as well as existing assets. This was managed through meticulous planning and close collaboration with Dragados, London Underground's Station Operations Manager and Dragados' Interface Manager.

Site teams received briefings on the planned works from Cleshar's Site Persons in Charge (SPC) when signing-in for each shift, and on any interfaces, their associated risks, mitigation measures and safe systems of working. In the weeks leading up

to the works, London Underground's Station Operations Manager would also have informed station staff of these upcoming works. For certain high risk activities, Cleshar's SPCs maintained radio contact with the Station Supervisor/Manager; in particular, these related to works in close proximity to fire alarms, monitors and other assets (which could not be removed).

During quieter periods in the day Cleshar staff were able to handle some materials within certain sections of the station under 'local agreement', but only following preparation of specific task risk assessments.



- **Working in a congested, multi-occupied worksite:** There were often several project teams working alongside each other in each worksite/area, magnified by the fact that space was severely restricted and there was minimal open or available space for storage. Furthermore, while the enabling works were made up of a 'patchwork' of work elements located in different areas around the main Bank worksite, all of them lay on the critical path.

Cleshar prepared detailed programmes and staging diagrams for issue to and approval by Dragados and external parties. All working parties at Bank, together with appropriate external stakeholders, attended weekly meetings to discuss live work areas and upcoming works activities. The works activities from the agreed programme were transferred onto a live planning board covering the upcoming four weeks, identifying potential clashes, appropriate mitigation measures and critical items requiring joint agreement before activities commenced. Next day and night works and potential clashes were further discussed at morning and afternoon meetings with project managers. At site level there were joint meetings between site managers at the beginning and end of each shift. Senior management held separate weekly meetings to review high level programme issues.



Design: Development of the initial design within a restrictive, congested high risk environment with a variety of delicate safety critical assets presented an early challenge, requiring significant input from all parties, including consultants, multi-discipline engineers and specialists. Cleshar undertook detailed intrusive surveys, including core sampling, asset surveys, back-of-house and tunnel ring checks and general intrusive checks, to aid this process, working alongside the designers to generate buildable designs. A robust change control process was vital in managing subsequent unforeseen findings at construction stage.

Unforeseen findings: Bank Station was heavily bombed in World War II, in particular, in December 1940/January 1941, and has previously undergone refurbishment on several occasions. Existing record drawings for these refurbishments works tended to be inconsistent. Consequently, many unforeseen challenges presented themselves when construction demolition works started at the station. These ranged from road support beams in illogical positions, bent structural steelwork from the bomb explosions, defective walls, and damaged and live services in many of the works areas. Due to the criticality of the programme, Cleshar had to react on a shift by shift basis and, working alongside the various discipline designers, identify a quick and buildable solution, e.g. adapting the new steelwork to 'fit around' existing bent sections.

INNOVATION

Collaborative working: When co-locating the different teams at Bank, it was decided to group disciplines together rather than allowing each company to work 'in isolation'. This encouraged open and honest dialogue (and less formal than timetabled meetings), quicker and more effective decision-making, and an all-round better working environment and display of the right behaviours expected of everyone.

Health and safety co-ordination meetings:

Representatives from all parties involved in the Bank project attended monthly health and safety co-ordination meetings. Matters discussed included findings from Planned General Inspection (PGI) findings Near Miss and Tool Box Talk records, incidents and trend analysis, and any impact on the project, critical path, etc. As a result of these meetings, a 'joined up' solution could be reached to the benefit of future work activities and health and safety practice on the Bank project.

AWARDS: In 2014 the BSCU team won a Construction Excellence Award for Integration and Collaborative Working. Both Cleshar's involvement in the project and the overall BIM management processes deployed on it were key contributing factors to winning this award.

