

Crossrail C300/C410 Western Running Tunnels

Project detail

DURATION

2011 – 2015

PROJECT PARTNERS/STAKEHOLDERS

Lead agency:

Crossrail Ltd (UK)

Main contractors:

Ferrovial Construction, BAM International, Kier

CONTRACT VALUE

~\$800M AUD

CONTRACT TYPE

NEC3 – Option C: Target Cost

DESCRIPTION

The C300 and C410 Western Running Tunnels are part of Crossrail, the largest rail engineering project in Europe. C300 comprises two 7.1m diameter, 6.2km tunnel drives between portals at Royal Oak and Farringdon Underground Stations. The tunnels were driven using two purpose-built Earth Pressure Balance (EPB) tunnelling machines and lined with precast concrete fibre reinforced segments, manufactured in a purpose-built factory at Westbourne Park. C410 included the construction of the station platform tunnels and associated passages and escalator tunnels at Bond Street and Tottenham Court Road, as well as the Fisher Street Shaft and the crossover tunnels.

The twin bore tunnels threaded through some of the world's most complex territory, between existing underground lines, sewers, utility tunnels and building foundations from station to station at depths of up to 40m. Extensive utility diversions were undertaken, including National Grid Gas Mains, Thames Water supply mains and cable networks in Soho Square.

Procurement process

The key driver of the procurement of the Crossrail program of works was a clear focus on successful project delivery.

Utilising the collaborative framework (NEC3 – Target Cost) allowed all parties to approach problems with an aim for solving them, not relying on positioning or protecting themselves. When the project succeeds, everyone involved succeeds.



Delivery process

Management and Control of Ground Movements and Groundwater: Engineers in the 24/7 Control Room analysed settlement on a real-time basis, providing confidence that if any incident occurred it could be mitigated with immediate effect, protecting people and third-party assets. Specialist mitigation measures were developed, such as the piled solution installed beneath the 100-year-old Lord Hill's Bridge, which supports the Royal Oak London Underground (LU) Station.

When the TBMs passed underneath, movements remained stable and settlement recorded on the tracks was almost zero. The data obtained from the Crossrail project was provided to Ferrovial's collaborative research initiative within Massachusetts Institute of Technology (MIT) on the Assessment of Land Movement from Tunnelling, which will enable more accurate prediction of ground movements associated with future underground construction.

Project Gains through Works Integration: Ferrovial collaborated with Crossrail to merge the two separate Western Running Tunnels (C300) and station caverns (C410) contracts, resulting in significant cost and risk reductions. Merging the contracts facilitated the adoption of a different construction methodology, with the TBMs being driven through the new station tunnels. The station tunnels were then enlarged by breaking out from the running tunnel using the tunnel as the pilot. An additional crossover tunnel was constructed in advance of the tunnelling, with the spoil from the station tunnel excavation removed using the TBM conveyors to the portal where the spoil was transported by rail. This approach reduced the overall settlement of the station tunnel excavation.

Working collaboratively with rail transport operators and other work packages: On-time completion was achieved as a direct result of Ferrovial's robust

interface management and cooperative approach to working with other contractors. A pragmatic approach to underground site boundary management, identified program interfaces and a phased handover to other works contractors all contributed to the early project completion, and demonstrates Ferrovial's ability to effectively manage complex interfaces for improved project outcomes.

Effective collaboration with other Package Contractors enhanced safety and reduced risk. For example, while the TBMs passed through the Bond Street and Tottenham Court Road ticket halls, emergency access was gained via contractor sites working above at ground level. We collaborated closely on designing emergency procedures and staging full scale rehearsals. At Farringdon, at the heart of one of our five worksites, a LU signalling room for the area was located close to one of our grouting shafts. A protected route to this room – a walkway that provided LU personnel with safe passage at any time to support rapid response to an emergency such as a signal failure – was maintained. When personnel arrive, all work on the site was ceased immediately, allowing them to reach the room unimpeded and with no distractions such as noise or dust. Banksmen along the route ensured that no traffic crossed in their path.

In Crossrail, a re-sequence of the construction program was conducted to allow another contractor's TBM break into the eastern end of our Farringdon, Whitechapel and Finsbury Circus sites. Our ability to undertake this change demonstrated flexibility in our planning and resourcing and our ability to support the Project overall. We adopted a phased handover to other Package Contractors of the platforms at Bond Street, Tottenham Court Road, Whitechapel and Finsbury Circus, enabling earlier final completion via a pragmatic approach to Interface/underground site boundary management. We collaborated closely with other contractors and Crossrail to ensure all program interfaces were accommodated

Outcomes and achievements

Key Project Outcomes:

- A phased handover to contractors of the platforms at Bond Street and Tottenham Court Road enabled earlier final completion through a pragmatic approach to interface/underground site boundary management. Close collaboration with other contractors and Crossrail Limited accommodated all program interfaces. Our dedicated Community Liaison Manager activated a high quality and consistent approach to stakeholder management.
- At peak production, the TBMs each advanced up to 40m per day, excavating more than 3,000t and installing 575t of concrete tunnel lining rings.
- \$32.4 million was saved through our Optimised Contractor Involvement (OCI) proposals, including a recommendation to merge the C300 and C410 contracts. Additional proposals during the works have saved a further \$27.2 million.

- Time efficiencies were achieved through concurrent compensation grouting/monitoring arrangements which resulted in fewer temporary shafts and tunnels. In addition, the manufacture of tunnel segments at Westbourne Park enabled precast segments to be manufactured to the construction program.
- Employing almost a third of all Crossrail apprentices built a lasting legacy. Together with the Tunnelling and Underground Construction Academy, we developed skills and resources for future projects in and beyond London.

With over 40 sites running concurrently across the Crossrail program, the collaborative contract model facilitated an environment where everyone worked flexibly alongside many contractors and stakeholders ensuring best-for-project outcomes; phased handover to other contractors enabled earlier final completion via a pragmatic approach to interface/underground site boundary management; collaborated closely with other contractors and Crossrail Limited to accommodate all program interfaces; and, Consents Manager acquired approvals and permissions in a timely manner.