Concrete complexity

Cordek and RMD Kwikform have been working with Laing O'Rourke to solve a challenging formwork issue at Crossrail's Tottenham Court Road station in London

MEMBER PROJECTS

Tasked with forming four geometrically complex concrete rings at the intersection of the running tunnels and the station box at the Tottenham Court Road Crossrail station, contractor Laing O'Rourke turned to formwork specialists Cordek and RMD Kwikform to design a bespoke solution capable of achieving this part of the project.

Crossrail is working alongside Transport for London on the transformation of Tottenham Court Road Station. The £1bn expansion incorporates a new station building the length of three football pitches, four storeys underground.

As part of this development, Laing O'Rourke required a lightweight solution for the construction of four different sized concrete tunnel collars, of up to 9.45 m diameter, to very tight tolerances. Key to the success was a solution that was robust enough to be assembled above ground and then lowered into the underground ticket hall.

Laing O'Rourke project engineer Alex Fleming says: "Getting this part of the project right was extremely important, as we were forming the start of the inner tunnel lining. We needed to ensure that the four tunnel openings were designed with the project environment in mind. The challenge was how to design a circular collar solution that was relatively lightweight and could be manoeuvred into place in a confined area, with restricted craneage."

RMD Kwikform designed a circular core formwork support structure from standard components. This faceted frame used Superslim soldiers within a

steel Slimshor frame, providing support to the outer formwork. Cordek then created a 3D CAD model of the angled tunnel intersection and designed the profile of the formwork required.

Keystone effect

Cordek designed the formers as segments to be assembled on the RMD Kwikform frame prior to installation, incorporating overlapping joints to give an effective seal and create a 'keystone' effect, forming a predetermined striking sequence. These were designed to fix to the outer profile of the multi-faceted frame using timber walers on marine plywood, which held the formers rigidly in position as they were subjected to pressures of up to 60kPa during the concrete pour.

The formers were machined out of Filcor 70 EPS to the precise tunnel profile, using a combination of CNC hot wire

60kPa
Highest pressures during the concrete pour

cutting and 5 Axis Machining to achieve the complex geometry and tight tolerances required. The concrete forming surfaces of the Filcor were sealed to ensure the pieces would strike and to provide a smooth concrete finish.

The Laing O'Rourke temporary works department helped to co-ordinate the interface between the RMD and Filcor former, as well as help finalise the design.

Tunnel opening
The largest most complex intersection was the eastbound tunnel opening, which intersected the main station box at an angle. This required the Filcor 70 EPS segments to be tapered so that the RMD Kwikform frame could remain a consistent profile throughout. The RMD Slimshor frame was set perpendicular to the main wall with the incoming tunnel at an angle, requiring the tunnel lining formers to be planer surfaces on the inner face and curved to form the surface of the concrete ring externally.

The combined formwork solution enabled Laing O'Rourke to position the invert and sidewall formers first before finally craning the crown section into place. Once the concrete had been placed, the units were struck in reverse order from the top down by gradually disassembling the supporting frame.

This was an interesting formwork problem, which emphasised how important it is to engineer solutions capable of achieving complex geometric shapes that are right first time. By combining the specialist expertise of Cordek and RMD Kwikform, it was possible to come up with a workable and practical solution within the project parameters.