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SUCCESS STORY

Sprayed Concrete Solution on Crossrail C410

Tottenham Court Road and Bond Street Stations

Fisher Street Crossover Caverns

London, UK

CLIENT:

CROSSRAIL C410, LONDON

CONTRACTOR:

BAM FERROVIAL KEIR JV



> THE PROJECT

The Crossrail Sprayed Concrete Lining (SCL) design at C410 is comprised of a permanent sprayed concrete primary and secondary lining for both the main underground stations at Tottenham Court Road and Bond Street. The SCL design was to be used for all platform tunnels, concourses and cross passages, and also included ventilation tunnels and shafts. Further to C410 were two crossover caverns and a shaft at Fisher Street.

> THE JOB CHALLENGE

The challenge was to develop a pumpable, flow retaining wet-mix sprayed concrete that could be delivered from either an on-site or off-site batching plant to meet the early strength requirement of "J2 modified" and the physical properties of a permanent, durable, fibre reinforced sprayed concrete lining.

During the project further requirements were addressed including fire protection sprayed concrete finishing layers and also regulating layer mixes for the successful application of spray applied waterproofing membranes.

The key challenge on Crossrail C410 was balance the Contractor's need for an economical, logistically smart solution, with the Client's requirements of safe, early age strength development coupled with long term durability and mechanical performance.

> THE SOLUTION

Normet worked full time with the BFK JV team in developing and fine tuning concrete mixes further from the successful trial period, and eventually defined two mixes based on open time - a 4 to 6 hr mix for site batched concrete, and a 8 to 10 hr mix required to facilitate off site batching and delivery through the busy London area. Both mixes used Normet's TamCem 60 high performance plasticizer and TamCem HCA hydration control admixture, the latter being used to extend the open time of the mixes.



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The early age strengths required for the project were initially based on the addition of 6% TamShot 80AF AFA set accelerator at the nozzle, and later this increased slightly as the project demanded higher earlier strengths from and age of 10 mins.

Mix Constituent	Quantity (kg/m³)
Ketton CEM I	420
Elkem MicroSilica	25
Normet TamCem 60 Superplasticiser	4.2
Normet TamCem HCA Hydration Control Admix	4.2 - 8hr 2.1 - 4hr
Bekaert Dramix 35/75	35
6mm Limestone Aggregates	629
Dagenham Sand	1168
Water	146
TamShot 80AF AFA Set Accelerator	6-8%



Later into the project at Fisher Street, the BAM JV team employed Normet spraying equipment to improve the quality, in particularly the homogeneity of the sprayed concrete lining, by using Normet's latest "pulsation free" pumps and robots, such as the Spraymec 8100, NorStreamer and Minimec. Using such equipment also demonstrated it was feasible to

reduce accelerator dosage as the spraying performance was optimized.



PROJECT OUTCOME

The BFK JV projects (including C435 Farringdon Station) was a significant major sprayed concrete tunneling project beneath key high value structures in London. The logistic control of the mix and supply arrangements enable the contractor to reduce downtimes and wastage to a minimum, whilst achieving very high performance permanent sprayed concrete for both primary and secondary lining shells. The value of high quality, low pulsation spraying equipment was also evident with the use of Normet's spraying equipment, where all layering effects from "normal" spraying equipment were solved, allowing the contractor to reach the long term concrete properties required by the project.