

Case study



MagnaDense concrete in London's Elizabeth Line

Reducing vibration and overcoming hydraulic pressure in Europe's largest infrastructure project.

LKAB Minerals



Floating track slab preparation at Tottenham Court Road. Source: ©Crossrail Ltd.

Connecting one of the world's busiest capitals from east to west, Crossrail is Europe's largest infrastructure project, connecting much of central London.

Situated more than 30 metres below the surface, sections of the project required solutions to overcome foreseeable problems such as ground borne noise and vibration to hydrostatic pressure.

Crossrail, now known as the Elizabeth Line, is one of the most transformative infrastructure projects involving LKAB. The project, which officially opened in 2022, has introduced a remarkable 42 kilometres of new tunnels, constructed 10 brand-new stations, and upgraded 30 existing ones.

The line spans from Reading and Heathrow in the west to Shenfield and Abbey Wood in the east, the Elizabeth line provides vital transportation across London. This expansion has increased London's rail capacity by 10%, significantly reduced journey times, and enhanced accessibility for millions of passengers. It is a project that LKAB is incredibly proud to have been a part of.

Reducing vibration

Beneath the Barbican and Soho, a high density Floating Track Slab (FTS) has been installed, designed to reduce the impact of noise and vibration caused by trains. The FTS is a known system already in use in Europe. However, use of a high density concrete, produced with the Swedish natural aggregate MagnaDense, is the first of its kind.

Due to the volume constraints of the tunnel, surrounding infrastructure and gauge of the train, space was limited. The solution was to develop an FTS with a target density of 3.6t/m³, limiting ground borne noise and vibration.

Concrete design

The high density Floating Track Slab sections at Tottenham Court Road and Farrington required 4,400 cubic metres of concrete with a density of 3.6t/m³. The concrete had to be pumped up to 980 metres within the tunnel network, a world record for pumping heavy weight concrete.

At its peak, the pipeline held 12.3m² or 44 tonnes of material. Pumping was performed at three locations; Bond Street, Fisher Street and The Barbican, with a total of 70 pours achieved during the project.

London Concrete, working alongside LKAB Minerals, developed a flowable concrete with an open life of 4 - 5 hours, meeting the stringent requirements of such a complex project.

Overcoming hydrostatic pressure in underground walkway

A secondary section of dense concrete was required for first stage concrete works at the Victoria Dock Portal and Pudding Mill Lane because of their proximity to the River Thames. Here, high density concrete was required to overcome hydrostatic pressure. Again it was not possible to increase the volume of concrete due to restrictions in space. Therefore, a dense concrete was developed using MagnaDense alongside the concrete contractor, P.J. Davidson.

PROJECT FACTS: Eastern Route

Heavy concrete: 500m³

Density heavy concrete: 3.4t/m³

Concrete producer: P.J. Davidson



Pudding Mill Lane

The completed track at Pudding Mill Lane, where high density concrete was used. *Source: © Crossrail Ltd.*

Logistics; both long and short distance challenges

The logistics of supplying large quantities of heavy aggregate to the centre of London just when it was needed were far from simple. With extensive knowledge in the moving of minerals around the world, LKAB Minerals ensured the material was delivered to the correct place, on time and as cost-effectively as possible.



Facts about MagnaDense

Compliance with Standards:

EN 12620 and DIN 6847-2

Particle Density (dry):

4.8 - 5.1t/m³

H₂O Absorption: <0.3%

Particle Shape: Angular

Surface Texture: Rough

MagnaDense, a natural high density solution

The natural iron ore material MagnaDense is suitable as an aggregate and as a loose ballast for a number of applications. With a specific gravity between 4.7t/m³ and 5.2t/m³ and availability in different fractions, MagnaDense is an ideal aggregate for producing heavy concrete.

Concrete produced with MagnaDense can be pumped over long distances without segregation. It mitigates the exotherm that normally occurs in thick sections of concrete, thus any tendency for stress-cracking to occur is reduced.

MagnaDense has CE certification and is approved to EN12620. It has a long history of use as a construction material and apart from its weight, shows similar characteristics to those of standard density concrete.

MagnaDense concrete can be placed by skip or pump.

Crossrail Facts

The name changed from Crossrail to the Elizabeth Line in honour of Queen Elizabeth II.

The Elizabeth Line is not categorised as a tube line because the trains are almost double the size of tube trains, so it uses the National rail network.

During work on the line, archaeologists excavated approximately 3,000 human skeletons from a burial site at Liverpool Street in 2015.



PROJECT FACTS: Farringdon & Tottenham Court Road

Heavy concrete: 4,400m³

Density heavy concrete: 3.6t/m³

Pumping distance: 980 metres

Self-compacted: Up to 25 metres

Subcontracting company: ATC JV

Concrete producer: London Concrete

We are leading the transformation of our industry toward a sustainable future.

LKAB Minerals, the international industrial minerals division of LKAB, develops and delivers circular, critical and climate-efficient mineral products. LKAB Minerals has sales representation, offices, production units and deposits in 12 countries in Europe, Asia and the US and employs around 400 people.

LKAB Minerals is part of the Swedish company LKAB, one of the world's leading producers of highly upgraded iron ore products and a major supplier of mineral products for other industrial sectors.

Read more about LKAB Minerals at www.lkabminerals.com



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