ADFIL
Construction Fibres

CASE STUDY

PASSIVE FIRE RESISTANCE
Precast Tunnel Segments
Northern Line Extension

London, United Kingdom

As part of the ongoing improvements to the London Underground System, Transport for London (TfL) approved the extension of the Northern Line to Battersea, to help regenerate the Vauxhall, Nine Elms and Battersea areas, supporting 25000 new jobs and more than 20000 new homes. Two new stations are to be built at Nine Elms and Battersea Power Station, targeted for completion in 2020. The line extension is constructed using interlocking precast tunnel segments containing steel fibre reinforcement and monofilament micro synthetic fibres. Morgan Sindall were awarded the contract to produce the precast tunnel lining segments.

Project owner
Transport for London (TfL)

Product
Monofilament Micro Fibre

Function
Specified to provide passive fire resistance in precast tunnel segments

Contractor
Ferrovial Agroman / Laing O'Rourke Joint Venture

Volume
21,000m³ Precast Tunnel Segments

Precast Producer
Morgan Sindall

Challenge

Explosive spalling of concrete when it is exposed to fire, is a serious problem in a tunnel environment. Airflow through the tunnel creates a chimney effect which increases temperature and exacerbates the severity of the fire.

Passive fire resistance reduces explosive spalling by eliminating the build up of steam from water within the concrete that has been vaporised by the heat from the fire.

The steam build up results in the face of the concrete being blown off with high energy release, posing a serious hazard to emergency services.

Solution

- The inclusion of an appropriate tested dosage of monofilament micro synthetic fibre provides passive fire resistance to the precast concrete segments which make up the lining of the tunnel structure
- The heat of a tunnel fire melts the filaments of micro fibre which creates micro channels within the concrete structure, allowing steam to move through the concrete, preventing a build up of pressure.
- Fire curve testing to simulate the fire environment is carried out to ensure the micro fibre dosage is sufficient to provide the level of passive fire resistance required in this type of application.

The monofilament micro synthetic fibre is added at the specified dosage during the fully automated batching process, before the concrete mix is placed and compacted into the tunnel segment moulds at the Precast Facility.

Precast tunnel segments ready for transport to site and installation to provide the tunnel lining of the Northern Line Extension.

Benefits of the solution

- The micro synthetic fibre is added into the concrete during batching.
- The mixing action distributes the fibres throughout the whole volume of the concrete ensuring the required performance.
- The precast facility manufacturing the tunnel segments is provided with a specified dosage of micro synthetic fibre confirmed by fire curve testing to ensure passive fire resistance is provided in the application environment.
- The addition of micro fibres will also improve the plastic properties of the concrete during precast production, reducing finishing inconsistencies and reducing breakages during demoulding and handling.

Result

- The Client is safe in the knowledge that the tunnel lining will not be prone to explosive spalling should a tunnel fire occur.
- Emergency Services will be at significantly less risk from explosive spalling whilst fighting a tunnel fire, reducing potential casualties and allowing more time for a safer escape for any trapped civilians.
- Micro fibres are easily introduced to the precast tunnel segments during production. This is a cost effective and efficient method of providing passive fire resistance in a tunnel application.

Products Used: Monofilament Micro Synthetic Fibre

Monofilament Micro Synthetic Fibre
Provides passive fire resistance to reduce explosive spalling of the concrete tunnel lining in the event of a fire. A continuous length of fibre is cut to specified length during the production process before addition to the concrete mix.

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