

Queensferry Crossing

World's largest underwater concrete pour



Our reference in Fife (United Kingdom): Queensferry Crossing

The background

The new Forth Replacement Crossing, a cable-stayed bridge known as the Queensferry Crossing, is Scotland's largest infrastructure project in a generation.

The £790m bridge was designed and built by Forth Crossing Bridge Constructors (FCBC), a consortium comprising Hochtief Solution, American Bridge International, Dragados and Morrison Construction, for client the Scottish Government. The project set a new world record for the world's largest continuous underwater concrete pour during tower foundation works.

The challenge

The main challenges in such a large non-stop process were logistical: ensuring a constant supply of raw materials to the batching plant and the use of established batching procedures ensured that the right quality of concrete was produced.

The operation to infill the tower caissons with underwater concrete was the subject of detailed planning for many months.

On completion, the pour caissons were emptied of water, cleaned and prepared for the next stage of construction – the creation of reinforced structural concrete foundations that will support the three 210m-high towers.

Project:

Queensferry Crossing

Location:

Fife

Client:

Scottish Government

Main contractor:

Forth Crossing Bridge Constructors

Concrete producer:

Forth Crossing Bridge Constructors

Market sector:

Ready-Mixed Concrete

Products used:

MasterGlenium SKY 903

MasterSet R 200

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Our solution

FCBC worked extensively with Master Builders Solutions to design and deliver a mix capable of being specification compliant whilst providing high strength, consistent workability, long retention times and high flow characteristics. The challenges posed by the project resulted in the development of MasterGlenium SKY 903, engineered to allow high levels of water reduction and extended workability retention, without sacrificing early strength development performance or having any negative effect on the construction program. Preliminary laboratory work identified that incorporating a modern generation set retarder MasterSet R 200, gave further confidence and concrete uniformity, enhancing placing and finishing operations.

The south tower underwater concrete plug involved a continuous 15-day operation with concrete being poured into a mass foundation 24 hours a day. After batching, the concrete was delivered by a continuous flow of 8m³ loads to the quayside and pumped onto purpose-built bespoke barges, each capable of carrying a total of 72m³, with six static 12m³ concrete mixers on deck. The concrete was then pumped from the barges into the foundation caissons through a special floating tremie pipe. Concrete 'flowed' approximately 20 metres under hydrostatic pressure and settled correctly, with any trapped air driven up to the surface as the concrete rose.

FCBC had to consider possible delays such as weather and breakdowns; a set retarder (MasterSet R 200) was used to provide extended retention times in excess of 12 hours. As the concrete level rose, the seawater inside the caisson was displaced.

The customers benefit

- World's largest underwater pour
- Carefully designed concrete mix and logistical preparation, Master Builders Solutions provided support on site throughout the entire pour.
- More than 30,000 cubic metres of underwater concrete to the three caissons.
- The largest single pour for the South Tower foundation was over 16,869 m³ of concrete

Project facts at a glance

- The South caisson alone involved more than 2,100 truck mixer deliveries and 250 barge trips.
- Solution developed through working closely with contractor.
- Each complete barge cycle took up to four hours.
- Non-stop process, 24 hours a day, over 15 days which, at its peak, involved up to 100 people.

