

Towering above the Forth

As work gets underway on the construction of the bridge's three towers, **Jaime-Wilson Castro**, FCBC Section Manager for Foundations & Towers, describes the processes and technical challenges which lie ahead.

Over the last few weeks, the massive operation to pour underwater concrete into the Central Tower cofferdam and the North and South Tower caissons was successfully completed (see Project News on page 2). This milestone meant that work could start on the reinforced concrete bases for the bridge's three towers.

The Central Tower (CT) base was completed in early August. This was followed by the historic casting of the first tower section (or "lift") in a continuous pour of 290m³ of concrete lasting over 15 hours. On the North Tower (NT), we are now installing steel "rebar" reinforcements in advance of pouring 4,000m³ of concrete into the de-watered caisson during October to form the tower's base. Meanwhile, the South Tower (ST) caisson has also been de-watered and preparation for the structural concrete base is underway.

Over the past 15 months, the marine foundations team has done a fantastic job getting the underwater works for the foundations to this stage. Now, it is our job – literally – to build on their success and start moving upwards.

Our plan is to construct all three towers in parallel, albeit staggering the start dates on each. The CT is the first to get underway. Now that the first tower section has been completed, it is time to install the complex steel structure which will hold the access platforms and formwork (see Q&A article on page 6) which essentially acts as a mould in which to cast each new hollow



"Birdcage" sections take up position

concrete section. We call this structure a "birdcage": a secure steel framework which contains all the necessary infrastructure to build each new section whilst enabling our construction teams to work safely at height.

Each birdcage will rise up, section by section, with the towers. They have been specially designed so they adapt in size to the changing geometry of the towers which taper elegantly all the way to the top.

Readers may be interested in some statistics. The towers we are constructing will be the highest of any bridge in the UK. At 210 metres, the CT will be slightly taller than the North and South Towers (202 metres) and will require a total of 54 sections. At peak activity, about 40 highly qualified people will be working on each tower. The CT will comprise 8,900m³ of concrete (8,500m³ for NT and ST). In addition, 2,500 tonnes of steel reinforcement will go into the CT (1,800 tonnes for each of the other towers) and each tower will also have 400 tonnes of steel "stay boxes" which will anchor the bridge's all-important stay cables to the towers. I am often asked how heavy the

towers will be. In all, the CT will weigh a staggering 22,000 tonnes!

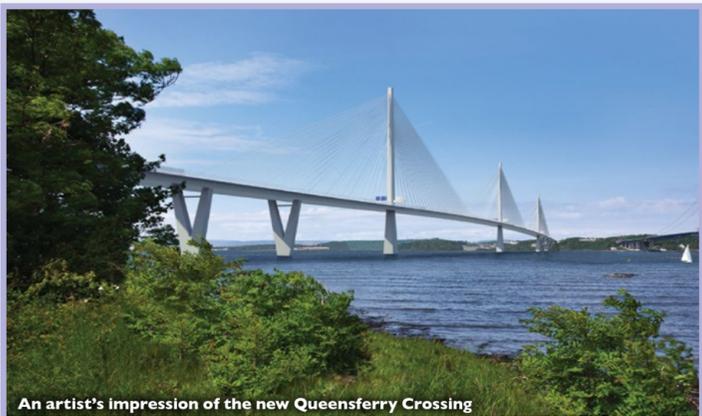
The engineering technology on this project has been tried and tested on other major cable-stayed bridges completed in recent years around the world. The main challenge we face here is the weather – and wind in particular. Accurate weather forecasts are vital to our work. The Met Office issues a site specific weather forecast every day at 7am which not only contains the forecast for the following 24 hours, broken down into hourly segments, but also gives us a five-day look ahead with anticipated wind speeds at various heights above the surface of the Forth. So we will have plenty of advance notice of any adverse weather conditions headed our way. If wind conditions are predicted to exceed certain levels, then we can re-schedule our work accordingly.



"Birdcage" structure almost complete on Central Tower

Another challenge will be making sure the concrete for each section is transported up the tower on time. The FCBC concrete batching plant in Rosyth Docks will mix the concrete before it is ferried out on barges – just as with the recent underwater concrete pours – from where, using special high-capacity pumps, it will be pumped up through vertical pipes located inside the towers. At the maximum height, the weight of concrete inside the pipes will be around six tonnes, so this will be a highly technical operation in its own right.

One more statistic which helps demonstrate the sheer size of the towers: during construction, each tower will feature two external hoists to lift personnel and materials up to where they are needed. These hoists travel at 40 metres per minute – which means that when the towers are at maximum height it will take a full five minutes to reach the top.



An artist's impression of the new Queensferry Crossing



Temporary, but vital for success

The term "temporary works" is not well understood outside the construction industry. We talk to **Neil Robinson**, FCBC Temporary Works Co-ordinator for Foundations & Towers, to find out why the work of his team is so important to the success of the Forth Replacement Crossing project.

Q What are temporary works?

A Temporary works cover a wide range of infrastructure equipment which makes the construction of the permanent works (ie. the new bridge itself and the connecting roads) possible. Every construction project – from the Pyramids to the new Queensferry Crossing – requires temporary works. Scaffolding is a good example. It enables the people and materials required to construct, say, a house to get to where they are needed. Without temporary works, nothing would ever get built!

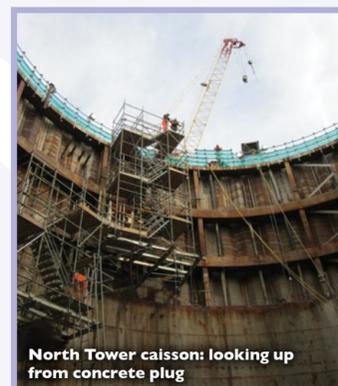
Q What are the main temporary works on this project?

A In my area of responsibility (the towers and foundations), the main temporary works are called climbing formwork. Made from steel and timber, these are essentially moulds used to form the four metre high concrete sections which will make up the bridge's three towers. The formwork on this project has been specially designed to be adaptable in size. As the tapering towers rise section by section, the formwork will rise alongside ready to mould each successive section, ultimately forming the tallest bridge towers in the UK at up to 210 metres. As far as the bridge foundations are concerned, the enormous steel caissons and cofferdams are essentially temporary

works which were vital to allow construction of the reinforced concrete tower bases. Elements such as scaffolding, ladders, gangways, hoists, lifts, crane foundations and safety rails all made access to the site possible. Indeed, the giant shearleg crane used to place the caissons on the seabed was technically part of the temporary works equipment.

Q What are the biggest challenges facing the team?

A With a project of this type, we continue to face big challenges as construction work progresses. The caisson and cofferdam installations were major challenges, but we now progress onto the tower and pier construction using a total of five sets



North Tower caisson: looking up from concrete plug



North Tower caisson: looking down from concrete plug

Q What gives you the most satisfaction?

A They say a temporary works engineer like me doesn't just see *what* has been built but always asks *how* it was built. At the end of this project, like any other, we know that our work will either be invisible or will have been removed altogether. But we will also have the satisfaction of knowing that nothing could have been built in the first place if it had not been for our input. So, now that the caissons have been successfully sunk into the seabed and the tower foundations are underway, we can be proud of the role the temporary works team is playing in this massive project.

project update

October 2013



The only way is up: Central Tower concrete pour completed and first tower section successfully cast



Contacting the FRC team

There are a number of ways you can contact us to ask questions, provide comments, make a complaint or find out more about the Forth Replacement Crossing project:

Call the dedicated 24 hour Project Hotline **0800 078 6910**

Email the team **enquiries@forthreplacementcrossing.info**

Log on to the project website at **www.forthreplacementcrossing.info**

Or drop into the **Contact & Education Centre** Adjacent Forth Road Bridge Administration Office, South Queensferry, Edinburgh EH30 9SF

Opening times
Mon-Thu: 0900-1700, Fri: 0900-1600, Sat: 1000-1600



Project Directors' update

Latest progress from around the Queensferry Crossing project.
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Technical Focus

Construction of the bridge's towers is now underway. Find out more about what's involved.
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Q&A article

Nothing gets built without 'temporary works'. We ask why they are so important to the success of this project.
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Forth Crossing Bridge Constructors

Concrete evidence of progress

In August and September, work on the foundations of the new bridge's three towers reached an important milestone.

Inside the North and South Tower caissons, the operation to create the enormous concrete "plugs" on which the reinforced concrete tower bases will rest was completed successfully. In addition, the foundations and first 4 metre high section of the Central Tower were cast. This means that we are now 'out of the water' and beginning to build upwards.

In previous issues, we have written about the technical challenges involved in undertaking the complex underwater concrete pours. These involved over 28,000m³ of concrete transported on a fleet of specially designed barges from the on-shore batching plant to the site of the foundations out in the Forth Estuary. These operations have gone very smoothly and it is a pleasure to congratulate the entire foundations team on a job well done. Work is continuing apace on the viaducts which will carry the roads to and from the new bridge itself, with the supporting piers and foundations steadily progressing.

In this issue, you can read about the many technical challenges which lie ahead as the focus now turns to building the major elements of the bridge's towers. Now that we are working in dry conditions and heading upwards, over the next few months the progress we are making in constructing Scotland's biggest infrastructure project for a generation will become obvious to local people and travellers crossing the Forth Road Bridge.

Elsewhere, work on the north and south connecting roads is progressing well. These roads will connect the Queensferry Crossing to the existing road network. They are currently being constructed "off-line" which means that existing traffic flows are unaffected. It is worth noting that the work on the connecting roads is worth around £110 million, a significant proportion of the entire principal contract cost and, by any standards, a major roads project in itself. The progress being made is clearly visible from the existing roads and surrounding areas.

Interest in the project, from both members of the public and the press & media continues to increase. Community Open Days, held in the Contact & Education Centre, and visits by local groups, schools and TV news crews are a regular part of life on the project. This will only increase, we believe, as the progress on the ground and out on the water becomes increasingly visible.



David Climie and Carlo Germani



John Swinney MSP visits the Queensferry Crossing site

Bridge budget reduced

Finance Secretary, John Swinney MSP, visited the FRC site on September 11th to reveal that the overall cost of the project is set to be £145 million lower than previous estimates. The lower cost is a result of successful management of the project and the delivery of key milestones.

Mr Swinney said: "It is very positive news for Scotland that the Scottish Government is further reducing the budget range for the Forth Replacement Crossing project to £1.4 billion to £1.45 billion. 90% of supply orders and nearly 60% of sub-contracts have been awarded to 365 Scottish firms and currently around 870 people are employed on the site.

"While there is no room for complacency, these latest figures also show that Scotland's biggest infrastructure project in a generation is being well managed. I commend all those involved for their hard work in this success so far, as construction continues on time and under budget.

"This is testament to the efficient management and effective delivery of the project by Transport Scotland and its partners in the Forth Crossing Bridge Constructors (FCBC) consortium."



Viaduct steel arrives

August saw the arrival on-site of the first of the steel deck sections which will make up the viaduct roadways which will carry traffic to and from the bridge. These were fabricated by Cleveland Bridge in Darlington and are pictured at the southern abutment area from where they will be launched out over the viaduct piers during the course of 2014.

A World Record for the Queensferry Crossing!

The operation to create the huge concrete plugs inside the tower foundations got underway in late July with 7,400m³ being successfully poured into the North Tower caisson.

This was followed in early August by a 4,400m³ concrete pour into the Centre Tower cofferdam. Next came a world record for the Queensferry Crossing project: a total of 16,869m³ of concrete was poured into the South Tower caisson to form a plug over 26 metres in depth. This represents the world's largest ever continuous underwater concrete pour. We also believe that it is the third biggest concrete pour of any type ever undertaken.

This record breaking 24/7 task took just over 15 days to complete. The concrete was delivered by four barges from FCBC's batching plant in Rosyth Docks. In total, the barges made 273 separate journeys to and from the caisson, covering 1,800 kilometres (roughly the distance from John O'Groats to Land's End). The weight of the concrete poured into the South Tower caisson was almost 39,000 tonnes, the equivalent of 3,250 London buses (without passengers).

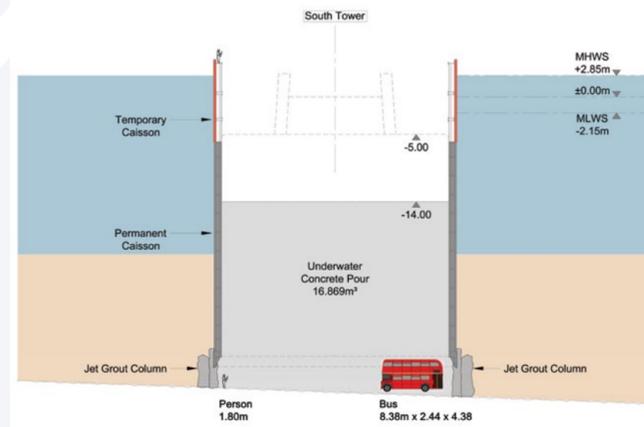
Carlo Germani, FCBC Project Director, said: "The underwater concrete pour operation has gone without a hitch thanks to extremely detailed advance preparation carried out by the team. This achievement is a credit to the skills of everyone involved. It is a huge milestone for the project because it means that the focus can now switch from below the waves to the upward construction of the three towers above the waters of the Forth."



The Foundations team celebrating the record-breaking concrete pour



Concrete pour operations at night



M9 Junction 1a turns green

With some 70,000 trees now planted and grass beginning to establish itself thanks to some warmer weather over the summer, the new M9 Junction 1a is starting to blend into its surroundings. The Junction fully opened in February and motorists are benefitting from the new slip roads to and from West Lothian and the improvements to the slip roads and the M9 itself towards Newbridge. The overhead gantries displaying variable mandatory speed limits are in use most weekdays at peak times, managing the heavy traffic flows heading towards Newbridge and the M8, whilst buses are able to take advantage of the hard shoulder bus lane to bypass any congestion.



Blending in: recent aerial view of the new M9 Junction 1a

Name the Bridge Schools Competition – Winners Announced

Pupils from Cleish Primary School in Kinross-shire and Madras College in Fife have won an amazing prize to attend the Official Opening Ceremony of the new Queensferry Crossing when it is completed. The recent Name the Bridge Schools Competition – one prize each for primary school and secondary school entries – was part of Transport Scotland's campaign to ask the public to vote for a name for the new bridge. Schools were invited to take part in the competition by entering their school name in a special prize draw. Seven lucky pupils and two teachers from each school will attend the bridge's Opening Ceremony. In addition, 25 pupils from each school will be given the opportunity to come on a tour of the Queensferry Crossing construction site in the school year 2013/14.



Scottish Transport Minister, Keith Brown MSP, draws out the winning school names

Contact & Education Centre Open Days

Since opening the doors of the FRC Contact & Education Centre (CEC) to the public in April 2013, over 1,200 people have taken the opportunity to visit the Centre. During our Open Days, members of the public have a unique opportunity to examine the detailed scale models of the bridge, read our information boards, view a presentation on the current works and also to ask project related questions to the staff building the new bridge. They can also take in the stunning panoramic view of the Forth Bridges from the CEC's main exhibition space.

Dates for your diary: the next Open Days will be held between 10am and 4pm on 18th and 19th October and 15th and 16th November. Presentations will run hourly from 10:30 onwards each day. We look forward to meeting you this autumn!



Viewing the bridge models and exhibition

Contact the Community Liaison Team

If you would like to speak to the Community Liaison team – perhaps you have an idea for a new community initiative or would like us to come and give a presentation on the latest developments – please see the contact details on the back page.

www.forthreplacementcrossing.info



BBC's "One Show" comes to town

The increasing level of public interest in the construction of the Queensferry Crossing was reflected recently by a request from the producers of the BBC "One Show" to come on-site to compile a piece on the bridge's progress to date.

The day kicked off at the Contact & Education Centre where the crew filmed the models of the new bridge and the wonderful views of the Forth Bridges. Then the thickest fog we have experienced so far on the project rolled in (just what you don't want when you have a TV crew in town!) so we moved on to Port Edgar jetty where, using a fish tank, a pump, two perspex cylinders and a few gallons of water, presenter Marty Jopson mounted an effective demonstration showing the difference between caisson design and installation methods used by Victorian engineers working on the Forth Bridge in the 1880s and our own operations in the 21st century.

Next, we boarded one of the FRC boats to go out to the North Tower site where key construction personnel were interviewed standing on the concrete plug down in the bowels of the caisson – 16 metres below the surface of the Forth. On the way back to shore, the fog lifted just enough for some atmospheric misty shots of the three bridges to be captured.

The One Show's 5 million viewers can see the film during the next few weeks, so keep an eye on the TV schedules.