

Forth Replacement Crossing

# project update

November 2016



**RECORD HOLDER**

**Cause for celebration:** the Queensferry Crossing Centre Tower deck span, at 644 metres, has been officially recognised as the longest, free-standing, balanced cantilever structure ever built anywhere in the world.

## Project Directors' Update

A round up of the latest progress on the Queensferry Crossing construction project.

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## Photo Update

Our four page photo spread brings you up to speed with all the latest action on-site. Plus: news of a Guinness World Record!

**Centre Pages**

## Technical Focus

Closing the gaps: with the deck construction nearing completion, we take a look at how the final deck sections are installed.

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## A World Record for the Queensferry Crossing

Welcome to the latest edition of the Queensferry Crossing's "Project Update" newsletter. Significant progress has been made in the past three months and the final shape and appearance of the bridge is now very clear for all to see.



David Climie & Michael Martin.

This may account for the comments we sometimes receive from members of the public suggesting that the bridge must be almost finished. In fact, there remains a lot of detailed work to do between now and the opening of the bridge.

But, first, an update on recent progress. In September, we lifted the last of 36 deck segments on to the Centre Tower. This has resulted in the Centre Tower span becoming the longest free-standing, balanced cantilever structure ever built (644 metres), a feat of engineering officially recognised in October by Guinness World Records. We are delighted with this achievement.

In total, we have installed 104 deck segments (at the time of writing) out of a total of 110. In July, we achieved the first "closure" on the Project when we joined the North Tower span to the northern approach viaduct. This was followed, in October, by the closure of the gap between the Centre and South Tower deck spans. These closure operations are always important and technically challenging milestones on any bridge construction project. Two more principal closures remain to be carried out on the Queensferry Crossing. The final – and historic – closure will be between the South Tower and the southern approach viaduct. When this stage is reached, we will be able to complete the on-going casting of the concrete deck surface on the southern approach viaduct. (Turn to "Technical Focus" on the back page for details of the technical challenges involved in achieving these large-scale closures.)

We are on schedule to complete the casting of the deck surface on the northern approach viaduct by the end of the year. This is what the final road surface will be laid on. Nearby, on land, work is continuing on the new and re-positioned Ferrytoll roundabout which opened to traffic in mid October, handling local traffic travelling to and from the Queensferry Crossing and the North Queensferry, Rosyth and Inverkeithing areas. It has been a tremendously complex operation to create a new roundabout in a slightly different position while keeping the existing junction open to traffic. In September, a new temporary northbound slip road to

the Ferrytoll junction opened which, in fact, uses what will become a permanent, dedicated bus lane link from the Forth Road Bridge once the new bridge is open. Our thanks go to motorists here – and, indeed, elsewhere across the site on both banks of the Forth – for their continuing understanding and patience which has done much to minimise any potential traffic disruption.

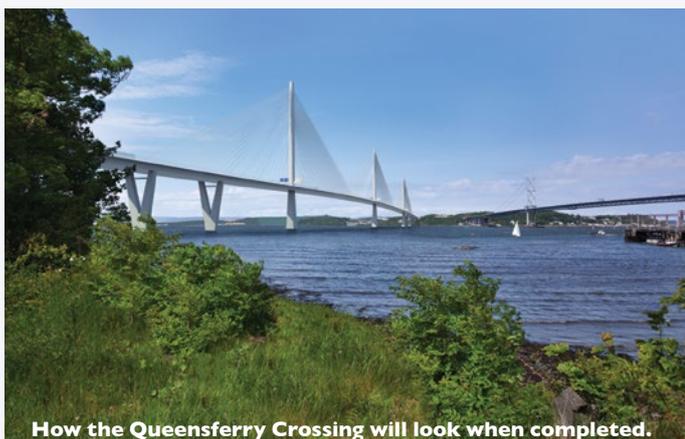
On the southside network connections, the laying of the final road surface on the new stretch of M90 motorway between the Queensferry Crossing and the existing trunk roads is scheduled to be completed by the end of the year. All ten of the new motorway signage gantries have been successfully installed. Resurfacing works on the B800 between the Tesco roundabout and the existing A90 Queensferry junction are continuing, together with the installation of a new bus lane, and should be complete in November.

This autumn will see us complete the removal of most of the remaining temporary steel formwork on the towers. This will include the remaining tower-top formwork on the Centre Tower as well as the tall, triangular trestle structures beneath each of the deck spans. Eagle-eyed passers-by will have noticed that the dismantling has already started of the blue deck-top "erection traveller" cranes used to lift the individual 750 tonne (on average) deck segments up 60 metres (200ft) from barges into position.

Also now gearing up is the mechanical, electrical and plumbing (MEP) works. This involves the installation of the electrical systems needed to power the street lighting, sign gantries and architectural lighting on the outside of the bridge, as well as the complex dehumidification systems for the deck segment "tubs" and the structural health monitoring and fire detection systems. Also needing power will be the maintenance shuttle monorail system and the tower elevators which will be installed next year.

Once all four deck closures are completed, the final road surface will have to be laid across the bridge, along with the wind-shielding structures, expansion joints, sign gantries and navigation lights on the bridge structure itself. Future issues of this "Project Update" will look in detail at these all-important elements.

So, as you can see, great progress is being made and much remains to be done. We are immensely proud of what is being achieved out there – often in hostile weather conditions – by a first class team of committed and skilled people who are all working hard to complete this magnificent, world-class bridge to the highest possible standards.



How the Queensferry Crossing will look when completed.

**David Climie**  
Transport Scotland Project Director

**Michael Martin**  
FCBC Project Director

## “Bang Goes the Borders” Science Festival 2016

In September, Andy O’Kane, FCBC’s Networks Structures Manager, attended the annual “Bang Goes the Borders” science festival at St Mary’s School in Melrose where he spoke to over 600 up-and-coming scientists and engineers about the Queensferry Crossing and explained some of the construction techniques and materials being used on the project.

“Bang Goes the Borders” is aimed at families and is sponsored by Heriot Watt University. It has been run at St Mary’s School in Melrose since 2010 and has significantly increased in size year on year. This year, schools and universities from across the UK gathered to give presentations, mount exhibitions and conduct workshops looking at a range of modern technical, biological and scientific challenges ranging from building rocket-propelled model cars, constructing major bridges, designing lightweight kayaks (and putting them to the test on the nearby River



**Budding civil engineers in Melrose enjoy learning about how the Queensferry Crossing is being constructed**

Tweed) to mixing bacteria with antibiotics and treating germs with probiotics.

Liam Harvey, Headmaster of St Mary’s School, commented: “We are hugely grateful to Andy O’Kane for his contribution to the success of the science festival. The Queensferry Crossing is a fascinating engineering project and it was inspirational for pupils, parents, teachers and other exhibitors to hear all about the construction of this wonderful



new bridge. Andy was inundated with visitors to his room, all eager to learn as much as they could.”

## Queensferry High Visits FCBC Laboratory



**Lab inspected and approved, FCBC’s Sharon Johnson delivers a load of newly batched concrete.**

Also in September, pupils from Queensferry High School visited FCBC’s materials testing laboratory in Rosyth dockyard as part of “Concrete in the Classroom”, an educational programme for secondary school pupils designed to give them a basic understanding of concrete technology and the employment options available within the sector.

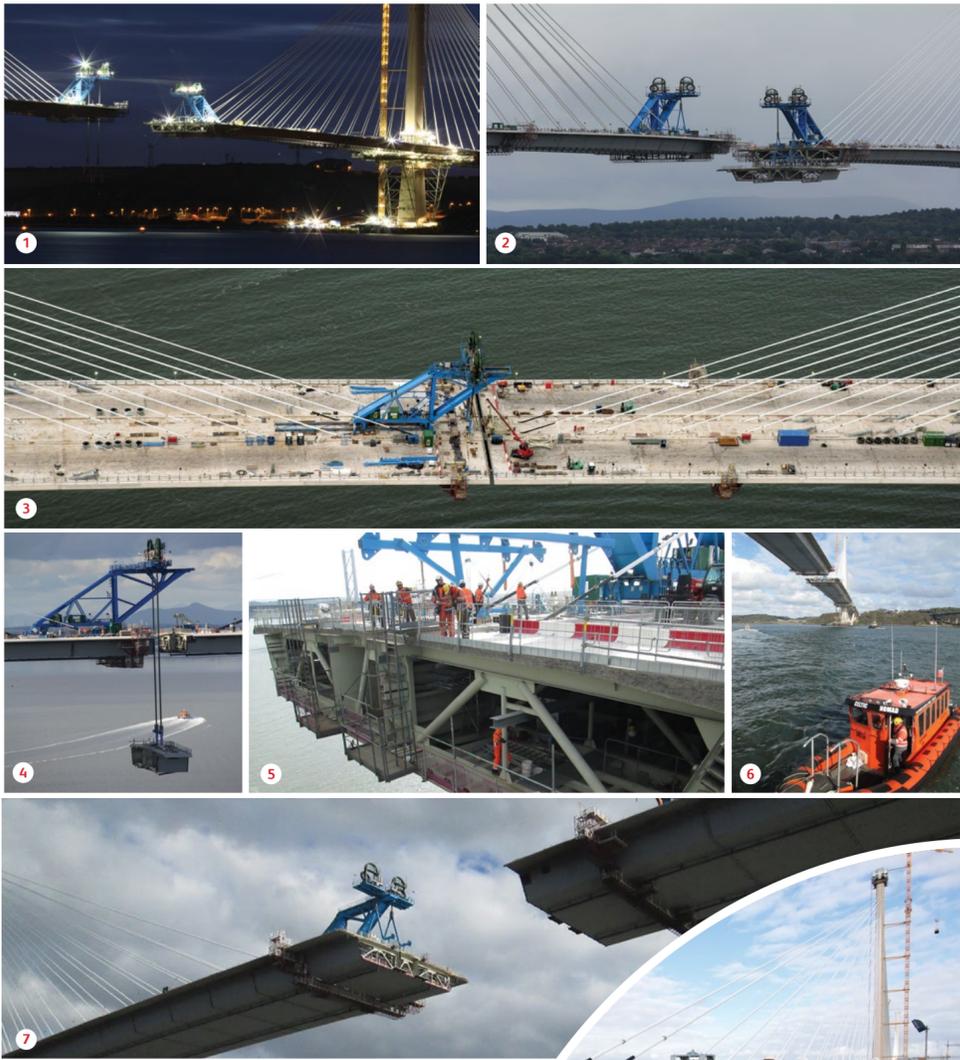
Concrete Scotland, supported by the Construction Industry Training Board (CITB) Scotland, arranges site visits to concrete plants, manufacturing facilities and construction sites so that pupils can contextualise their learning experiences in the real world of work.

For Queensferry High School pupils, where better for a site visit than the Queensferry Crossing right on their doorstep? After all, the bridge will be made up of approximately 80% concrete when complete and is already the holder of the world record for the largest quantity of concrete (16,869m<sup>3</sup>) ever poured continuously under water.

During the visit, the S3 pupils were able to see the various material tests that typically take place on large construction projects. One of the pupils remarked: “I hadn’t realised the number of different jobs in construction until we visited the Queensferry Crossing. It was quite an eye-opener.”

Nicola Wilkie, Science teacher at the school, commented: “The pupils were engaged with the process and it was an excellent opportunity for them to find out what was happening in their own community. They have had an excellent experience in developing their knowledge of the construction industry.”

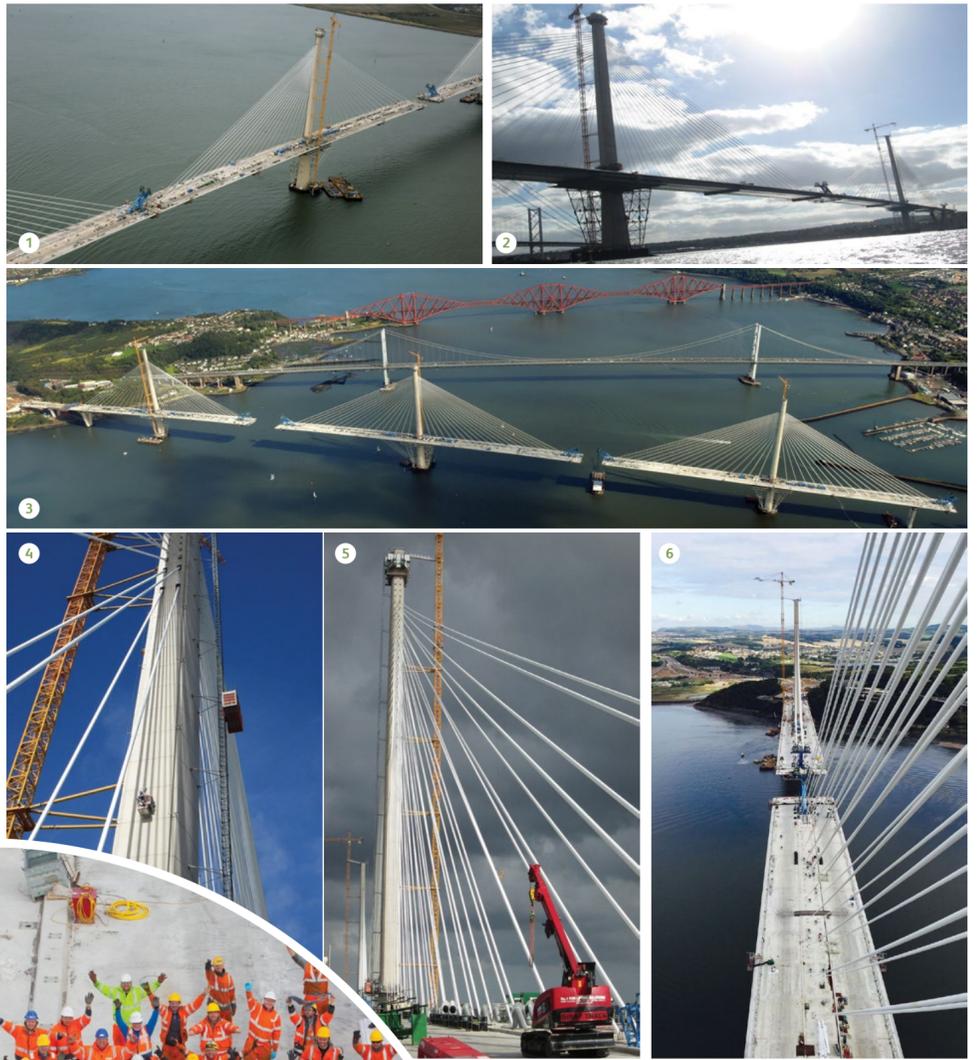
Dale Lyon, Director of Concrete Scotland, added: “We are grateful to FCBC for facilitating such a great visit which incorporated an overview of the Queensferry Crossing construction project as well as the fascinating visit to the site’s materials testing laboratory.”



**DECK:** 1 Night-time view of Centre Tower & South Tower deck spans at point of maximum temporary vertical deflection. The deflection (up to about 4 metres) is caused by length of cantilever and weight of deck sections being lifted. 2 Another deck section is lifted into place on the South Tower. 3 After the South Tower/Centre Tower closure deck section has been lifted into place and attached to the South Tower deck, a tiny gap remains before the section is joined to the Centre Tower deck, achieving full closure. 4 The South Tower/Centre Tower closure deck section makes its way towards its destination. 5 Close up view of the end of the Centre Tower deck span as the gap between it and the South Tower gets ever smaller. 6 A crew boat arrives at the Centre Tower with the North Tower in the background. 7 Not far to go now: the gap narrows between the North Tower and Centre Tower road decks.



Standing proudly on the southernmost deck section of the Centre Tower span as Shantha Chinniah, Guinness World Records Senior Adjudicator, presents the certificate to Iain Cookson and colleagues.



**TOWERS:** 1 Aerial view showing the joining of the South and Centre Tower decks in October. 2 It's not always fair weather out in the middle of the Forth but, when it is, it makes a great picture! 3 A unique site: three iconic bridges spanning three centuries, each representing the highest standards of civil engineering of the time. 4 Passing traffic: the North Tower hoist (on right) heading down to road deck level passes the upward bound basket taking two team members up the side of the tower to continue stay-cable installation operations. 5 Stay cables are the signature feature of the Queensferry Crossing. Here they cascade down to road deck level from the Centre Tower. 6 A spectacular view from the top of the Centre Tower looking towards the North Tower.



The Centre Tower construction team celebrates their world record achievement.

**VIADUCTS:** 1 A rainbow frames the new bridge and the southern approach viaduct. 2 General view of the northern approach viaduct and the North Abutment. The temporary cladding on top of the structure is to provide weather protection for the on-going concrete deck laying operations. 3 The southern approach viaduct is supported on eight massive, V-shaped, reinforced concrete piers. 4 Preparation work underway for the next concrete deck pour on the southern approach viaduct. Note the criss-cross of steel bars over which the concrete will be poured producing incredibly strong reinforced concrete. 5 A concrete pour underway on the deck of the northern approach viaduct. 6 Aerial view of the 543m long southern approach viaduct. Note separate structures for north and southbound traffic.

Centre Tower Construction Manager, Iain Cookson (left) with FCBC Project Director, Michael Martin, and Centre Tower Senior Engineer, Calum Henderson.



**It's a World Record!**

The Queensferry Crossing construction project has broken another world record. In October, the Centre Tower deck span, measuring an incredible 644m in length, became the longest, free-standing, balanced cantilever structure the world has ever seen. This unique feat of engineering was officially recognised by Guinness World Records in a ceremony on the Centre Tower on 7<sup>th</sup> October. The achievement has been the cause of celebration by the entire Project team. Iain Cookson, FCBC Centre Tower Manager, said: "Ever since we lifted the first of the 36 deck sections into position in September 2015, this has been a tremendous team effort. We are incredibly proud of what we have built. The Queensferry Crossing is an amazing construction project to be involved with. We will all be lucky if anything else comes close to matching it in the rest of our careers!" Messages of congratulations have come in from around the world as well as from people in Fife, Edinburgh and West Lothian, reflecting the pride local people feel in the new, world class bridge being built in their midst.



**ROADS:** 1 View of new M90 South Queensferry junction showing new roundabout, slip roads and final carriageway surface on northbound carriageway. Next stage – finish the southbound carriageway and landscaping. 2 Aerial view of new motorway as it approaches the new bridge from the south. 3 The new stretch of A90 where it joins the existing A90 south of the Forth Road Bridge is almost complete. Final road surface, white lines, overhead sign gantries, lamp posts, anti-noise fencing and landscaping are all in place. 4 Aerial view of the complex roadworks at Ferrytoll, north of the Queensferry Crossing, where the construction of a new motorway flyover bridge, a re-positioned roundabout, creation of new bus-lanes and a re-routed B981 to and from North Queensferry have been achieved while keeping all existing roads open to traffic. 5 Installation of the large overhead sign gantries on the new stretch of M90 south of the new bridge was carried out day and night. 6 Laying the road surface on the newly repositioned Ferrytoll roundabout just north of the Queensferry Crossing. The new roundabout was fully opened to traffic in October. 7 A technique called 'echelon paving' was used to lay the final road surface on the new length of dual carriageway outside South Queensferry. This reduces the number of surface joints needed by using three tipper lorries and up to 30 people to lay the 'black top' simultaneously across the whole width of the new road.





## Closing the Gaps

A significant construction milestone was reached in October with the closure of the gap between the Centre and South Tower deck spans. Here, **Martin Romberg**, Senior Design Engineer with the Queensferry Crossing's Design Joint Venture, explains the challenges involved in closing the gap successfully.

We have now lifted and installed 104 out of a total of 110 deck sections which will eventually form the Queensferry Crossing's motorway road deck which, in less than a year's time, will be carrying tens of thousands of vehicles across the Forth every day. The operations to lift the huge composite steel and concrete deck sections, weighing an average of 750 tonnes, into place 60m (200ft) above the waters of the Forth have been described in previous issues of this "Project Update" (see, for example, the September 2015 issue available online at address below).

Our focus now is on closing the gaps. At 6.1m by 40m by 5m, the deck sections used to close the gaps between the main deck spans are smaller than the main deck sections but, nevertheless, weigh a massive 300 tonnes. It is a technically challenging operation to slot these sections into place because the space to be filled between the main deck spans, constructed over the

past 14 months, is incredibly narrow. In fact, as the section completes its journey upwards, we only have 100mm clearance on either side, representing exceptionally tight tolerances. So complete accuracy during the entire lifting operation is absolutely vital.

To help with this, we push the entire South Tower deck span back by 300mm using powerful hydraulic jacks attached to the South Tower itself. This creates a gap sufficiently wide to allow the closure deck section to slip into place. The next step is to join the newly arrived section to the South span in much the same way as all the previous deck sections have been installed – by welding it into place before pouring a reinforced concrete "stitch" across the top of the joint to create the final deck surface on which the blacktop will eventually be laid. Unlike other deck sections, the closure sections are not bolted into place, but a series of temporary tension bars pull the two decks tightly together allowing the welding operation to take place.

Once the section is fully attached on one side to the South deck span, we are ready to attach the other side to the neighbouring Centre Tower deck. Before we can do this, however, it is vital to check that the horizontal and vertical alignments are an exact match. By altering the tensioning of the stay-cables supporting the already installed deck sections, we can lift the



two leading edges to exactly the correct geometry. When everything is ready, we slowly release the compression on the jacks at the South Tower so that the over 600m long South Tower deck span can move back the 300mm, thus closing the gap and allowing the other side of the closure section to be welded and concreted into position. When this is complete, full closure has been achieved.

A total of four principal closures will be carried out on this amazing construction project. So far, we have successfully achieved two. As with most things on this job, the principal challenge is the weather: Hundreds of measurements and checks are carried out before and during the closure operation to minimise the risk of anything going wrong 60m up, but the one thing we cannot control is the famous wind out in the Forth. Happily, the operation to close the Centre/South Tower gap went very smoothly and we now turn our attention to preparing for the next closure which will join the Centre and North Tower deck spans.



## 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**

Look for us online:

[www.forthreplacementcrossing.info](http://www.forthreplacementcrossing.info)

[www.queensferrycrossing.co.uk](http://www.queensferrycrossing.co.uk)

@FRC\_Queensferry

Or go to the Queensferry Crossing YouTube channel

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



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