How to build a road deck
As the construction programme reaches the next critical stage where deck sections and stay cables are installed, we take a look at the technical operations involved.

Connecting to the Queensferry Crossing
Latest news on the construction of the North & South Approach Viaducts and the network of connecting road works.

Final push for the top
The Queensferry Crossing’s 3 towers are nearing their maximum height and are now officially the UK’s tallest bridge structures.

We have lift-off! Out at the North Tower, the first of 110 deck sections is lifted up from sea-level to road deck height approximately 55 meters (180ft) above the waters of the Forth.
Welcome to the latest edition of the Queensferry Crossing “Project Update”. As ever, there is a lot of activity happening out on-site. Elsewhere, you can read about the progress being made across this fantastic, once-in-a-lifetime construction project. Out on the towers and on the emerging road deck, on the two approach viaducts and on the connecting roads north and south of the Forth, we continue to make good progress and remain on schedule to have traffic flowing across the new bridge by the end of 2016.

Recently, we have achieved a number of significant milestones of which the Project Team is proud. In August, the Queensferry Crossing’s three towers became the tallest bridge structures in the UK. We still have a little way to go before they ‘top out’ later this year at 210 metres in height (see back page) but already their height advantage over the towers of the neighbouring Forth Road Bridge is clear for all to see.

In July, we installed the first four stay cables on either side of the North Tower (see Centre Spread) and at the end of August their counterparts on the South Tower were also installed. These cables are very much the signature feature of the Queensferry Crossing, so it is very exciting to see them beginning to take their place in the bridge’s emerging architecture.

Then, at the beginning of September, the first of 110 deck segments was lifted into place at the North Tower (see Front Cover photo and Centre Spread) in a technically challenging operation which represents the leading edge of 21st century civil engineering technology.

Of course, as nobody can fail to have noticed, the weather this summer has been poor. Wind has been a particular feature out on the Forth and one that especially affects our ability to carry out operations at the tower tops and on the deck segments where working at such heights is subject to the most stringent health and safety considerations. Despite the weather, however, excellent progress has been made through careful logistical planning and timetabling, keeping any adverse effects to a minimum. It is a tribute to the skilled and dedicated workforce working across all areas of the Project that they have kept us on track in spite of the persistent winds. Our thanks to all of them.

This summer, we had the opportunity to climb to the top of the North cantilever of the Forth Bridge. It was only ten days after the famous old bridge had deservedly received UNESCO World Heritage Site status and it was an excellent chance to pay tribute to the magnificent structure where the history of bridges in this area all began. The scale and quality of our predecessors’ achievement and engineering prowess in the 19th century is breathtaking. As we in the 21st century add a new chapter to the history of bridges in this unique location, everybody working on the Queensferry Crossing remains fully aware of our responsibility to create a structure worthy of taking its place proudly alongside its illustrious neighbours.

Welcome

Michael Martin
FCBC
Project Director

David Climie
Transport Scotland
Project Director

Minister visits site

Keith Brown MSP, Cabinet Secretary for Infrastructure, Investment & Cities, recently welcomed news that the Project is now running with more than 1,200 workers on site, a new peak in direct employment levels.

Meeting members of the team during a site visit in August, Mr Brown said: “It’s great credit to the hard work and dedication of the men and women working on the Queensferry Crossing to see the progress made since my last visit. Everywhere you look, there are major operations underway or already complete.”

David Climie & Michael Martin admire the unique view from the top of the Forth Bridge

Meeting FCBC Project Director, Michael Martin, and Chris Hunt, Apprentice Site Engineer

Visiting the Queensferry Crossing or live nearby?

Become a part of the Project’s legacy with a quick click of your camera or smartphone.

Take a photo of yourself, family and/or friends with the bridge works in the background and you can become part of “Frame the Bridge”! Upload your photograph to help build the fantastic online “People’s Bridge” mosaic. Your photos will also form a key part of the celebrations when the bridge opens.

It couldn’t be easier.

Find out more at www.framethebridge.co.uk

David Climie, Michael Martin, Keith Brown, Chris Hunt

Minister visits site
FCBC helps Inverkeithing High achieve success

School teams from across Fife and Falkirk attended Fife College in May to compete in their regional Go4SET programme. Go4SET is a national initiative designed to promote STEM subjects (Science, Technology, Engineering and Maths) to 2nd year pupils. The Inverkeithing High School pupils were tasked with coming up with a creative idea for an ‘Eco Hotel’ and were awarded ‘Best Overall Project’ on the day. They improved their design and model for the final competition in Edinburgh and were commended for their team-working ability.

Chris Hunt, FCBC Apprentice Site Engineer, was asked to get involved to help the Inverkeithing team. According to Chris: “This was a fantastic opportunity to work with ambitious and enthusiastic youngsters and a chance to promote the civil engineering profession to 2nd year pupils about to make their course choices.”

Considerate Constructors – Gold Award No 3

FCBC and the Queensferry Crossing construction project won a Gold Award at this year’s Considerate Constructors Awards Scheme for the third year in a row – a fantastic achievement. The Considerate Constructors Scheme is designed to help constructors continually improve standards and the image of the construction industry.

Pictured is the FCBC team (Andy O’Kane, Ross Glendinning, Pedro Jadraque and Don Fraser) attending the Awards ceremony at the Balmoral Hotel in Edinburgh.

FRC CONTACT & EDUCATION CENTRE

EVENTS & ACTIVITIES

Over 20,000 people have visited the Forth Replacement Crossing Contact & Education Centre since it opened in April 2013 and it continues to host a range of events and activities:

PROJECT EXHIBITION
Open every Saturday 1000 – 1600 hours (March – October). Members of the public can explore exhibition panels about the FRC Project, view detailed bridge models, meet members of the Project team to learn more about the construction of the new Queensferry Crossing and enjoy spectacular views of the Forth.

PROJECT PRESENTATIONS
Presentations take place on the last Friday of every month at 1000 & 1300 hours (March – October). These include an in-depth look at the construction of the Queensferry Crossing and its connecting roads. The team also takes group bookings from universities, colleges, professional and community organisations interested in visiting for a presentation.

SCHOOLS PROGRAMME – FREE EDUCATIONAL VISITS
Our trained and knowledgeable staff lead a range of visits in the exhibition area which provides an excellent learning environment. Pupils participate in interactive and inspiring educational activities related to bridge construction, science, technology, engineering and maths.

To find out more about what’s on offer at the Contact & Education Centre, or to book a visit for your group, contact us via:
Email: frcenquiries@transportscotland.gsi.gov.uk Tel: 0800 078 6910

Flying the flag for the Queensferry Crossing

As part of FCBC’s mentoring programme with the University of Strathclyde, a group of international civil engineering students recently visited the Queensferry Crossing. The group included a number of post-graduate students from 18 countries: Brazil, Bulgaria, Czech-Republic, Finland, France, Hungary, India, Malaysia, Netherlands, Nigeria, Oman, Pakistan, Poland, Saudi Arabia, Spain, Sweden, Syria and Thailand.

How the Queensferry Crossing will look when completed

How the Queensferry Crossing will look when completed
Queensferry Crossing

Carson T. Carney, FCBC Cable Stayed Bridge Technical Manager

The Queensferry Crossing - the operations to lift the bridge's deck segments into place and install the signature features of the Queensferry Crossing. They consist of a varying number of large segments, each weighing 750 tonnes, which are lifted sequentially using an enormous crane to position the segments ready for the final road surface to be laid. Each deck segment is then lifted to its final position, one either side of each tower. These erection travellers will lift the deck segment up to deck height (approx. 80m) and then move laterally to the correct position which will allow for the release of the segments. Each segment is then moved up close to its neighbour and then welded together. This process, known as "rotation" is achieved through a series of girders which are threaded through an external, large diameter, steel anchor plate at either end. The final strand is cut to length and wedged into a position, completing the "rotation" process. This will be a significant milestone for the Project.

Road deck construction explained

This autumn marks the start of one of the most technically challenging periods in the construction of the Queensferry Crossing - the operations to lift the bridge's deck segments into place and install the all-important viaducts. Here, Carson T. Carney, FCBC Cable Stayed Bridge Technical Manager, explains the complex processes necessary to ensure all 110 deck segments are installed successfully.

Over the past two or three years, looking out across the south side of the Forth and members of the public have been able to see key elements of the new Queensferry Crossing growing in front of their eyes, weekend by weekend, month by month. The three main towers, for example, reaching their final heights and now significantly higher than the towers of the nearby Forth Road Bridge. The A90 Queensferry South Viaduct being steadily cleared out over the water.

What hasn't been so obvious is the ongoing work on the deck which will ultimately carry thousands of vehicles across the bridge every day. This is about to come to an end as part of building the amazing bridge. In this article we will look at the individual deck segments and the stay cables which will hold them up - finally filling the gap between the three towers and connecting to the viaducts. These segments will, for the first time, actually start to make a bridge out of the structure we are building.

As previously reported in the Project Update (see November 2014 issue), the first four deck segments on each tower have already been installed. These are connected directly to the towers supported by temporary "telescopic" trusses beneath. As the North Tower, the initial deck segments have recently been launched off the telescop and tied to give the required geometry to fit the graceful arch of the final completed road deck. This tilting - we call it "rotation" - was achieved through the recently installed first stay cables linking the weight of the deck for the first time in late August, a significant milestone for the Project.

Starting from early September, all subsequent deck segments will be lifted into position with the reinforced concrete deck already in place. Each segment will be fitted into FCBC's on-shore fabrication yard on the north side of the River Forth. This will be part of the "stage" described of the processes we will have to complete 110 times between now and the completion of the bridge deck.

Steps 1 & 2: Once the segment has been correctly positioned, it has to be fastened permanently to the tower. This is achieved by a huge amount of welding around the steel box frame of the deck segment and internal beams within it. This is a time-consuming operation but a critical one at any peril of becoming unstable. The internal welds of the reinforced concrete "tub" is bonded on top of the structure. The strand coming up with the welds, permanently secures the segment to its neighbours. These operations are constantly monitored by non-destructive tests to ensure proper welding is achieved after which permanent bolts complete the steel connections.

Steps 3: Once the reinforced concrete deck itself is being suspended, the stay cables have to be prepared. The stay cables are one of the all-important viaducts.

Approach Viaducts and Piers: progress update

A lot has been happening out on the north and south Approach Viaducts since the last issue of the Project Update. We catch up with Juan Jose Consuegra Perez, FCBC Approach Viaducts Manager, for a summary of the current state of play.

June saw the completion of Pier N2 on the south side of the road deck which will trigger the operation to launch the Approach Viaduct South into its final position. This successfully completed in July, the culmination of an operation which started in late 2013. At 543 metres in length and weighing 84,000 tonnes, this was a major project in its own right. Work is now progressing well with the placement of the main road surface. This will be followed throughout a good part of 2016.

As previously reported in the Project update, the northside which then triggered a major milestone for the Project.

As previously reported in the Project Update, June 2014 issue, the northside of the viaducts on the south side of South Queensferry, the so-called "experiment" viaduct has been completed. This supports the new M90 motorway junction to the north of South Queensferry and will see the completion of the abutment out of March 2015.

Meanwhile, construction of two adjacent slip roads to the new bridge continues progressing well. Pier P1 is scheduled for completion at the end of the year with V-shaped legs now emerging. In the next issue we will look at the raised permanent works on the north side of the River Forth. Next door, the foundations of Pier 22 and 23 are being prepared on the paddle-like structure from which the V-shaped legs will rise.

Steps 4: What hasn't been so obvious is the ongoing work on the deck which will ultimately carry thousands of vehicles across the bridge every day. This is about to come to an end as part of building the amazing bridge. In this article we will look at the individual deck segments and the stay cables which will hold them up - finally filling the gap between the three towers and connecting to the viaducts. These segments will, for the first time, actually start to make a bridge out of the structure we are building.

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Steps 3: Once the reinforced concrete deck itself is being suspended, the stay cables have to be prepared. The stay cables are one of the all-important viaducts.

The roads to success

The Queensferry Crossing would be nothing but a very prominent civil engineering ‘white elephant’ if it was not for the existing trunk road network on either side of the Forth. That’s where the work of FCBC’s Network Connections team comes in. According to Ross Glennie, FCBC’s Network Connections Manager, activity is progressing well on all fronts. Here’s a brief update.

Tuning to the south side, this flat, newly constructed M9 road bridge over the Firth was fully completed and in traffic service during July. The final temporary closure of the A95 route in late September, will allow the project to fully progress and be handed over to the local authority. This will mark a significant milestone for the Project.

On the north side, looking south down the M90…

The new B981/Ferrytoll Road/King Drive junction will be completed. This supports the new M90 motorway junction to the north of South Queensferry and will see the completion of the abutment out of March 2015.

Turning to the south side, this newly completed B90 road bridge over the Firth was fully completed and in traffic service during July. The final temporary closure of the A95 route in late September, will allow the project to fully progress and be handed over to the local authority. This will mark a significant milestone for the Project.

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Queensferry Crossing

Road deck construction explained

This autumn marks the start of one of the most technologically challenging periods in the construction of the Queensferry Crossing - the operations to lift the bridge's deck segments into place and install the all-important stay cables. Here, Carson T. Carney, FCBC Cable Stayed Bridge Technical Manager, explains the complex processes necessary to ensure all 110 deck segments are installed successfully.

Over the past two to three years, looking out across the fortress-like edifices and members of the public have been able to see key elements of the new Queensferry Crossing growing in front of their eyes, week by week, month by month.

The three main towers, for example, reaching ever higher into the sky and now significantly higher than the towers of the neighbouring North Road Bridge. Or the approaching V-shaped legs beneath the road deck, which will hold the bridge above the water.

What hasn’t been so obvious is the ongoing work on the deck which will ultimately carry many thousands of vehicles across the bridge every day. This is a task we are nearing the final phase of building the amazing bridge, installing the individual deck segments and the stay cables, which will hold up the giant structure.

### Approach Viaducts and Piers: progress update

A lot has been happening out on the north and south Approach Viaducts since the last issue of the Project Update. We catch up with Juan Jose Consuegra Perez, FCBC Approach Viaducts Manager, for a summary of the current state of play.

#### Approach Viaducts under construction

In late Autumn 2014, the first four pier segments on each tower have already been installed. These are connected directly to the viaducts supported by temporary, ‘falsework’ trestles beneath. At the North Tower, the initial deck segments have recently been lifted off the ‘falsework’ and titled to give the required geometry to fit to the geometry of the final completed road deck. Encapsulation, tilting – we call it “rotation” – was achieved by lifting the reinforced concrete deck into position using the enormous, yellow Tower Crane.

With the rotation process complete, the next major milestone will be the fitting of the connections to link to the tower. The deck segments will be lifted into place with the reinforced concrete deck already in place. This is a time-consuming operation as a critical support is put in place to support the reinforced concrete deck. Once this is in place, it can be tilted into the correct position for the bridge deck. The final deck segments and the stay cables will be fine-tuned to the correct position.

This is a very different operation to the phased launch of the longer Approach Viaduct South but no less complex in that it will involve “jiggling” the structure into place along the bridge line. As the two sections are joined, the leading edge of the newly installed deck segment will be positioned, at the tower site, the bridge is anchored – to within 200mm tolerance – then the stay cables are supported to be prepared. The stay cables are one of the signature features of the Queensferry Crossing. They consist of a varying number of strands (up to 110 strands in the largest cables), each strand made up of several wires, coated in a heat resistant coating, 6.2 millimetres in diameter. This means that, once in place, they are a very flexible, but strong, cable that is perfectly suited to the environments they have to carry. The strands are then each fitted in FCBC’s on-shore fabrication yard – the leading edge of the newly installed deck segment is currently being tested out on the north pier.

Stage 1 & 2: Once the segments have been correctly positioned, it has to be fixed permanently in place. This is achieved with a huge amount of welding around the steel box construction and internal beams within it.

Stage 3: After this initial work, the steelwork assembly on Approach Viaducts is nearing completion on the single box structure so that it ties in seamlessly with the structure we are building.

Stage 4: What hasn’t been so obvious is the change as we enter the next phase of construction at the tower site and the installation of the internal scaffolding, the stay cables and the installation of connecting drainage installations, the stay cables will be fine-tuned to the correct position. The processes we will have to complete 110 times between now and the completion of the bridge deck.

Stage 5 & 6: The remaining spans are then tightened through the piers using a winch and shackle system which binds the spans through the piers as a single unit. This is the last operation before the final launch into place on schedule in late July. The old bridge will be removed totally by this phase of construction at the northside which then triggered the construction on the south side.

Stage 7: The new bridge will be completed in late October which will be well on schedule in late July. The old bridge will be removed totally by this phase of construction at the northside which then triggered the construction on the south side.

Approach Viaducts will be complete. This supports the new M90 route in late October which will be well on schedule in late July. The old bridge will be removed totally by this phase of construction at the northside which then triggered the construction on the south side.

### The roads to success

The Queensferry Crossing would be nothing but a very prominent civil engineering ‘white elephant’ if it were to be completed unconnected to the existing trunk road network on either side of the Forth. That’s where the work of FCBC’s Network Connections team comes in. According to Ross Glendinning, FCBC’s Network Connections Manager, activity is progressing well on all fronts. Here’s a brief update.

#### Tuning to the south side

The newly constructed Bornholm Bridge in the AR9 was fully on line, with traffic successfully transferred to the new road on schedule in late July. This bridge is part of a major civil engineering project in its own right. Work is now underway on installing internal scaffolding, the stay cables and the installation of connecting drainage installations, the stay cables will be fine-tuned to the correct position. The processes we will have to complete 110 times between now and the completion of the bridge deck.

Turners have now completed the task of diverting the B995 road from the north side, looking south down the M90…

Standing on the new bridge looking west out over the two piers in a single operation.

#### Tuning to the north side

In late Autumn 2014, the first four pier segments on each tower have already been installed. These are connected directly to the viaducts supported by temporary, ‘falsework’ trestles beneath. At the North Tower, the initial deck segments have recently been lifted off the ‘falsework’ and titled to give the required geometry to fit to the geometry of the final completed road deck. Encapsulation, tilting – we call it “rotation” – was achieved by lifting the reinforced concrete deck into position using the enormous, yellow Tower Crane.

With the rotation process complete, the next major milestone will be the fitting of the connections to link to the tower. The deck segments will be lifted into place with the reinforced concrete deck already in place. This is a time-consuming operation as a critical support is put in place to support the reinforced concrete deck. Once this is in place, it can be tilted into the correct position for the bridge deck. The final deck segments and the stay cables will be fine-tuned to the correct position.

Stage 1 & 2: Once the segments have been correctly positioned, it has to be fixed permanently in place. This is achieved with a huge amount of welding around the steel box construction and internal beams within it.

Stage 3: After this initial work, the steelwork assembly on Approach Viaducts is nearing completion on the single box structure so that it ties in seamlessly with the structure we are building.

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Road deck construction explained

This autumn marks the start of one of the most technically challenging periods in the construction of the Queensferry Crossing - the operations to lift the bridge's deck segments into place and install the all-important stay cables. Here, Carson T. Carney, FCBC Cable Stayed Bridge Technical Manager, explains the complex processes necessary to ensure all 110 deck segments are installed successfully.

Over the past two to three years, looking out across the north and south approaches and members of the public have been able to see key elements of the new Queensferry Crossing growing in front of their eyes, week by week, month by month.

The three main towers, for example, reaching upwards ever higher into the sky and now significantly higher than the towers of the neighbouring Forth Bridge. Or the Approach Viaduct South being steadily constructed out over the water.

What hasn't been so obvious is the ongoing work in the deck segments that will ultimately carry many thousands of vehicles across the bridge every day. This is what we are about to reach next phase of building the amazing bridge, installing the individual deck segments and the stay cables that will hold them all together and fill the gap between the three towers and connecting to the viaducts; these segments will, for the first time, actually start to make a bridge out of the structure we are building.

As previously reported in the Project Update (see November 2014 issue), the first four deck segments on each tower have already been installed. These are connected directly to the viaducts supported by temporary telescopic towers. As the North Tower: the initial deck segments have recently been lowered from the 100-metres-high tower and tilted to give them the required geometry to fit to the girder, which is the final completed road deck will form. This tilting – called “rotation” - was achieved for the recently installed first stay cables using the weight of the deck for the first time in late August, a significant milestone for the Project.

Starting from early September, all subsequent deck segments will be lifted into place with the reinforced concrete already in place and welding has been completed to fit ICC's onshore fabrication yard on the left bank. This will be a typical way of working, for a good part of the year. Here is a brief “($.00))” description of the processes we will have to complete 110 times between now and the completion of the bridge deck:

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Steps 2 & 3: Once the segment has been correctly positioned, it has to be fastened permanently in place. This is achieved through a huge amount of welding around the steel box structure and internal beams within it. This is a time-consuming operation but a critical one as it is the anchor point to which the reinforced concrete “deck” will be joined onto top of the structure. This Blyth, with the welds, permanently secures the segment to its neighbour. Two people are constantly monitored by non-destructive testing inspectors to ensure perfect positioning, a task after which permanent bolts complete the deck connections.

Steps 4: While the reinforced concrete deck is being poured, the stay cables are to be prepared. The stay cables are one of the signature features of the Queensferry Crossing. They consist of a varying number of strands (up to 118 for the largest cables) that are threaded through an external, white pipe (essentially a covering or sleeve). Each strand is made up of eight high tensile, galvanised steel wires, 1.2 millimetres in diameter. Some of the wires, coated in wax, are wound in a helical pattern around central king wires. The strands are each contained in a high density polyethylene (HDPE) covering within a “basket” of about one metre in length. This is then tensioned to the required level by the winch and shuttle system which bring the stay cables to the tower site, the barge is anchored directly to the towers supported by temporary telescopic towers. As the North Tower: the initial deck segments have recently been lowered from the 100-metres-high tower and tilted to give them the required geometry to fit to the girder, which is the final completed road deck will form. This tilting – called “rotation” - was achieved for the recently installed first stay cables using the weight of the deck for the first time in late August, a significant milestone for the Project.

Steps 5 & 6: Remaining strands are then threaded through the pipe using a winch and shuttle system which bring the strands through the pipes once in place. Each strand is out to length and welded into a steel anchor plate at either end. The final result is one of the strongest steel cables in the world, capable of supporting the Queensford Crossing road deck for many decades to come. By the end of Step 6, the stay cables – two per deck segment – have been fully essentially tested and put to the weight of the deck segment is still primarily being controlled by the external tensioner cables. The stay cables are now tensioned up to full tension at which point the weight of the deck segment is transferred from the external tensioner cables to the stay cables.

Steps 7: The hydraulic powered, 250 tonne capacity crane can now move forward (typically 1.6 metres) on each side of the leading edge of the newly installed deck segment ready to lift the next segment making its way out of the line and – and the above cycle is repeated.

On completion of 110 deck segments installation, the stay cables will be finally adjusted to achieve the “global geometry” required by the design of the new bridge. Taking into consideration the massive weights and loads involved, the dramatic heights at sea and tide conditions will all play a critical role in achieving the “global geometry” required. The stay cables are constantly monitored by non-destructive test inspections to ensure perfect positioning after which permanent bolts complete the deck connections.

Approach Viaducts and Piers: progress update

Now see the completion of Pier N on the south side which then triggered the operation to launch the Approach Viaduct South into its final position, which was successfully completed in July, the culmination of an operation which started in the summer of 2010. At 543 metres in length and weighing 5,600 tonnes, the entire 5,600 tonne structure is launched out over the sea and tide conditions will all play a critical role in achieving the “global geometry” required. The stay cables are constantly monitored by non-destructive test inspections to ensure perfect positioning after which permanent bolts complete the deck connections.

Turning to the south side, the newly constructed B300 bridge over the A90 was fully functional as traffic began to use it on schedule in late July. The old bridge will be demolished in the autumn. This is anticipated to require by the design of the new bridge. The Queensferry Gyratory is essentially a new motorway sweeping round to approach road under construction. Just north of the Viaduct, work is on the new road surface. Turning to the north side, the newly constructed B300 bridge over the A90 was fully functional as traffic began to use it on schedule in late July. The old bridge will be demolished in the autumn. This is anticipated to require by the design of the new bridge.

Aerial view of the 1km segments

Aerial view of Approach Viaduct South

Aerial view of Approach Viaduct North

Approach Viaducts and Piers: progress update

A lot has been happening out on the north and south Approach Viaducts since the last issue of the Approach Viaducts and Piers: progress update newsletter. Work is now progressing well. Pier S1 is scheduled for concrete deck pour in late September while Pier N2 was successfully completed in March. Currently, we are working towards the construction of the west anchor box for the deck lift operation.

During this phase of the works is much more exposed, St Margaret’s Mains to improve irrigation and drainage at the bridge site, the bridge deck. But on route to the north side, the linking viaducts will be completed in March. Currently, we are working towards the construction of the west anchor box for the deck lift operation.

Steps 7: The hydraulic powered, 250 tonne capacity crane can now move forward (typically 1.6 metres) on each side of the leading edge of the newly installed deck segment ready to lift the next segment making its way out of the line and – and the above cycle is repeated.

On completion of 110 deck segments installation, the stay cables will be finally adjusted to achieve the “global geometry” required by the design of the new bridge. Taking into consideration the massive weights and loads involved, the dramatic heights at sea and tide conditions will all play a critical role in achieving the “global geometry” required. The stay cables are constantly monitored by non-destructive test inspections to ensure perfect positioning after which permanent bolts complete the deck connections.

Steps 4: While the reinforced concrete deck is being poured, the stay cables are to be prepared. The stay cables are one of the signature features of the Queensferry Crossing. They consist of a varying number of strands (up to 118 for the largest cables) that are threaded through an external, white pipe (essentially a covering or sleeve). Each strand is made up of eight high tensile, galvanised steel wires, 1.2 millimetres in diameter. Some of the wires, coated in wax, are wound in a helical pattern around central king wires. The strands are each contained in a high density polyethylene (HDPE) covering within a “basket” of about one metre in length. This is then tensioned to the required level by the winch and shuttle system which bring the strands through the pipes once in place. Each strand is out to length and welded into a steel anchor plate at either end. The final result is one of the strongest steel cables in the world, capable of supporting the Queensford Crossing road deck for many decades to come. By the end of Step 6, the stay cables – two per deck segment – have been fully essentially tested and put to the weight of the deck segment is still primarily being controlled by the external tensioner cables. The stay cables are now tensioned up to full tension at which point the weight of the deck segment is transferred from the external tensioner cables to the stay cables.
Queensferry Crossing

Road deck construction explained

This autumn marks the start of one of the most technically challenging periods in the construction of the Queensferry Crossing - the operations to lift the bridge’s deck segments into place and install the all-important stay cables. Here, Carson T. Carney, FCBC Cable Stayed Bridge Technical Manager, explains the complex processes necessary to ensure all 110 deck segments are installed successfully.

Over the past two or three years, looking out across the Forth estuary and members of the public have been able to see key elements of the new Queensferry Crossing growing in front of their eyes, week by week, month by month.

The three main towers, for example, reaching ever higher into the sky are now sooty grey and have grown significantly higher than the towers of the neighbouring Forth Road Bridge. Or the approach Viaducts South being steadily raised out of the water.

What hasn’t been so obvious is the ongoing work to the deck which will ultimately carry thousands of vehicles across the bridge every day. This is a task to be undertaken as part of building the amazing bridge, installing the individual deck segments and the stay cables, which will hold it all together.

June saw the completion of Pier 9 on the south side, which then triggered the operation to launch the Approach Viaduct South into its final position. Pier 9 was successfully completed in July, followed by an operation which started in late August. At 545 metres in length and 92 metres wide, with a total weight of 39,000 tonnes, this operation was a major civil engineering project in its own right. Work is now underway on installing internal scaffolding, chipping off and steel reinforcement along the entire length of the east and west carriageways. It’s the final piece of the jigsaw.

This will allow the FCBC team to begin providing the reinforced concrete deck segments which will be the main structure of the bridge over the water. The road deck will finally both rise and have the carriageways on it, and the entire project will now begin to take shape. In September, Pier 10 will be completed, followed by Pier 11.

With Pier 11 in place, work can begin on the Approach Viaducts North, where construction work has already started on Pier 8.

The Queenferry Crossing has the largest deck ever to be moved in Europe. It will require the movement of a 532-metre by 75-metre deck segment, weighing over 14,000 tonnes.

The deck will be moved in sections, with a series of jigs and cranes to guide it into place. The deck will be moved to form a single continuous structure, which will then be ready for road traffic.

To ensure the deck is moved on schedule, the deck must be removed from its fabric and moved to its final position. This involves lifting the deck into a temporary position, then removing the fabric and moving the deck to its final position. The deck is then moved to its final position using a series of jigs and cranes, which will be removed from the deck as it is moved.

The deck is then moved to its final position using a series of jigs and cranes, which will be removed from the deck as it is moved.

Approach Viaducts and Piers: progress update

A lot has been happening out on the north and south Approach Viaducts since the last issue of the Project Update. We catch up with Juan Jose Consuegra Perez, FCBC Approach Viaduct Manager, for a summary of the current state of play.

Tweaking the nuts and bolts of the deck: the scale of this construction project is obvious

As previously reported in the Project Update (see November 2014 issue), the first four deck segments on each tower have already been installed. These are connected directly to the towers supported by temporary “male” towers in front of the towers. At the North Tower, the initial deck segments have recently been “joined” to the “female” tower and are aligned with each other to give the final completed road deck. These sections were moved across the river prior to the construction of the towers. The road deck is then lifted into place with the reinforced concrete deck already in place at the tower site, the barge is anchored to the dockside fabrication yard on one of two step 1

Aerial view of Pier 9

Stage 1: Each deck segment weighing 150 tonnes average, is transported out from the fabrication yard on one of two huge barges positioned by tugs. On arrival at the tower site, the barges are secured to the leading edge of the newly installed deck segments suspended beneath the blue erection traveller cranes - to within a tight 200mm tolerance - then threaded through the pipe using a yellow Tower Crane. The stay cables are now tensioned from the leading edge of the newly installed deck segments suspended beneath the blue erection traveller cranes - to within a tight 200mm tolerance - then threaded through the pipe using a yellow Tower Crane. The stay cables are now tensioned.

Stage 2: By the end of Step 6, the segment has been correctly positioned, it has to be fixed to the tower and the bridge piers. To achieve this, a huge amount of welding around the steel box structure and internal beams will be required by the design of the new bridge. By the end of Step 6, the segment has been correctly positioned, it has to be fixed to the tower and the bridge piers. To achieve this, a huge amount of welding around the steel box structure and internal beams will be required. The segment is then lowered into the tower for the final time and the segment is lowered into the tower for the final time. The segment is then fixed to the tower and the bridge piers. To achieve this, a huge amount of welding around the steel box structure and internal beams will be required.

Stage 3: Once the segment has been correctly positioned, it has to be fixed to the tower and the bridge piers. To achieve this, a huge amount of welding around the steel box structure and internal beams will be required. The segment is then lowered into the tower for the final time and the segment is lowered into the tower for the final time. The segment is then fixed to the tower and the bridge piers. To achieve this, a huge amount of welding around the steel box structure and internal beams will be required.

Stage 4: When all the reinforced concrete deck segments have been correctly positioned, it has to be fixed to the tower and the bridge piers. To achieve this, a huge amount of welding around the steel box structure and internal beams will be required. The segment is then lowered into the tower for the final time and the segment is lowered into the tower for the final time. The segment is then fixed to the tower and the bridge piers. To achieve this, a huge amount of welding around the steel box structure and internal beams will be required.

Stage 5: The completed segment is then moved to its final position on the tower and the segment is lowered into the tower for the final time and the segment is lowered into the tower for the final time. The segment is then fixed to the tower and the bridge piers. To achieve this, a huge amount of welding around the steel box structure and internal beams will be required. The segment is then lowered into the tower for the final time and the segment is lowered into the tower for the final time. The segment is then fixed to the tower and the bridge piers. To achieve this, a huge amount of welding around the steel box structure and internal beams will be required.

Stage 6: The completed segment is then moved to its final position on the tower and the segment is lowered into the tower for the final time and the segment is lowered into the tower for the final time. The segment is then fixed to the tower and the bridge piers. To achieve this, a huge amount of welding around the steel box structure and internal beams will be required. The segment is then lowered into the tower for the final time and the segment is lowered into the tower for the final time. The segment is then fixed to the tower and the bridge piers. To achieve this, a huge amount of welding around the steel box structure and internal beams will be required.

Stage 7: The completed segment is then moved to its final position on the tower and the segment is lowered into the tower for the final time and the segment is lowered into the tower for the final time. The segment is then fixed to the tower and the bridge piers. To achieve this, a huge amount of welding around the steel box structure and internal beams will be required. The segment is then lowered into the tower for the final time and the segment is lowered into the tower for the final time. The segment is then fixed to the tower and the bridge piers. To achieve this, a huge amount of welding around the steel box structure and internal beams will be required.
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
- 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

Towers: final push now on towards completion

Christian Niemietz, FCBC’s Senior Engineer North Tower, is delighted with the progress being made with the construction of the Queensferry Crossing’s three enormous reinforced concrete towers.

“I do not believe things could have gone any better,” says Niemietz. “Of course, we have had challenges to overcome – you don’t expect anything else on a project of this scale – but all the concrete pours completed so far have been carried out very successfully and we are on target to top out all three towers on schedule this autumn. We are very proud of what is being achieved.”

In the past three months, several further concrete pours (each 4 metres high) have been successfully completed and 32 steel cable anchor boxes have been inserted inside the towers. To date, 50 pours have been completed on the North Tower; 47 and 46 on the South and Centre Towers respectively involving over 22,000 cubic metres of concrete in the towers and an additional 15,000 cubic metres for the foundations. The initial four deck sections at the North and South Towers have been concreted successfully, allowing cabling works to progress. This performance is a tribute to teamwork, says Niemietz, citing the FCBC joiners, jump teams, steel fixers, crane crews, scaffolders, the concrete batching team, temporary works team, surveyors and laboratory technicians whose joint skills have been vital to the efficient way the works have been carried out.

Progress has been steady despite the poor summer weather. Wind is a particular challenge when working at such heights and prolonged windy conditions since early June have been a particular feature this year. “Frankly, if you can cope with a Scottish summer like this one, you can cope with a Scottish winter!” says Niemietz.

So, what remains to be done? Well, each tower will eventually consist of 54 pours, so the next few weeks will see the remaining pours completed. Then a 6m x 4m precast concrete slab, complete with entry hatch and parapet walls, will be fitted across the top of each hollow tower structure, thus marking the completion of the tower construction programme. Down at road deck level, the operation is now underway to insert tensioned steel strands inside the already poured reinforced concrete deck slabs in an operation (called post-tensioning) which increases the strength of the final road deck, making it fit to carry the traffic load in the decades ahead.

According to Christian Niemietz: “Finishing these fantastic towers will be an amazing achievement and we are looking forward to a wee celebration to mark the event!”

Choppy waters: a barge brings concrete to the South Tower

Looking down, down, down from one of the Tower Cranes

Pouring the concrete deck at Centre Tower

A cable anchor box is installed at South Tower